REPORT RESUMES

ED 010 589 24

THE INFLUENCE OF DISCRIMINATIVE CONTEXT ON THE RELATIVE EFFECTIVENESS OF PERCEPTUAL AND GRAPHEMIC REPRESENTATIONS IN SECOND-LANGUAGE LEARNING.

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REPORT NUMBER BR-6-8727 PUB DATE 66
GRANT OEG-4-7-068727-0233
EDRS PRICE MF-$0.18 HC-$4.60 115P.

DESCRIPTORS- LEARNING ACTIVITIES, *LANGUAGE INSTRUCTION, JAPANESE, *GRAPHEMES, *LISTENING, *DISCRIMINATION LEARNING, READING COMPREHENSION, *PERCEPTION, GRADE 6, TRAINING, STANFORD, CALIFORNIA

THE TWO FOLD PURPOSE OF THIS STUDY WAS TO (1) INVESTIGATE THE RELATIVE EFFECTIVENESS OF GRAPHEMIC AND PERCEPTUAL REPRESENTATIONS IN TEACHING CONCEPTS OF FOREIGN LANGUAGE WORDS, AND (2) DETERMINE WHAT HAPPENS UPON PRESENTING SUCH REPRESENTATIONS IN THE CONTEXT OF OTHERS. FOR THE PURPOSES OF THIS STUDY, A PERCEPTUAL REPRESENTATION WAS DEFINED AS "A COLOR OR A LINE-DRAWING" OF AN OBJECT, AND A GRAPHEMIC REPRESENTATION AS AN "ENGLISH NAME FOR A COLOR, GEOMETRIC FIGURE, OR AN OBJECT." STUDY PARTICIPANTS WERE 136 SIXTH-GRADE PUBLIC SCHOOL CHILDREN. USING VARIOUS TREATMENTS, THESE CHILDREN WERE TRAINED FOR LISTENING COMPREHENSION OF 12 JAPANESE NAMES FOR COLORS AND OBJECTS, AND THEN TESTED FOR UNDERSTANDING OF THESE JAPANESE WORDS IMMEDIATELY AFTER TRAINING AND 1 WEEK LATER. READING COMPREHENSION WAS ALSO TESTED (ABILITY TO READ THE JAPANESE WORDS IN ROMANIZED SPELLING). FINDINGS INDICATED THAT PERCEPTUAL REPRESENTATION TRAINING RESULTED IN BETTER LISTENING AND READING COMPREHENSION THAN GRAPHEMIC TRAINING. TRAINING WITH OR WITHOUT DISCRIMINATIVE CONTEXT DID NOT RESULT IN SIGNIFICANT DIFFERENCES IN COMPREHENSION. (JH)

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THE INFLUENCE OF DISCRIMINATIVE CONTEXT ON THE RELATIVE EFFECTIVENESS OF PERCEPTUAL AND GRAPHEMIC REPRESENTATIONS IN SECOND-LANGUAGE LEARNING

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1966

This research was supported by a grant from the U.S. Office of Education, OEC - 4 - 7 - 068727 - 0233.

PREFACE

This research had its inception in work begun earlier by Mr. Kunihira at San Jose State College. Mr. Kunihira has had a long-term interest in variables influencing language acquisition. His earlier work studied methods of language instruction which required the learner to act out the actions described in words being learned. He demonstrated the utility of this procedure.

Obviously, not all language can be acquired in this fashion because not all language symbols can be readily translated into physical movements. When Mr. Kunihira began his doctoral study at Stanford University, he began to explore with me other kinds of instructional variables which might influence acquiring a foreign language. The study reported here represents one experimental test of the power of a set of variables potentially relevant to language acquisition.

Although the material being learned, the dependent variable in this study, is a limited portion of the vocabulary of a foreign language, the results of the study have relevance to the general problem of acquiring a symbol system. Since many symbol systems have both perceptual and graphemic representation, assessing the effects of various modes of presenting the symbol system to a learner has utility not only for instruction in foreign language but also for instruction in other subjects involving the acquiring of a symbol system.

We also hope that this experiment will illustrate for our colleagues in foreign language instruction the feasibility of a a rigorous experimental attack on the problem of language learning. In expressing this hope, we are not implying that they are particularly obtuse to the values of the experimental method. However, it is our impression that language instruction has had to depend on research done in classrooms and under conditions inimical to tight experimental control. To the degree that the methodology employed here is illustrative as well as instructive, it will stimulate experimenting in controlled situations to study how a foreign language may be acquired.

We are particularly grateful to the Palo Alto Unified School District and specifically to the principals, teachers, and children in the Barron Park, El Carmelo, and Escondido Schools. Their generous cooperation has made the conduct of this experiment possible.

We wish to thank Dr. E. R. Hilgard and Dr. R. L. Politzer of Stanford University for their many valuable suggestions and criticisms on the findings of this study.

F. J. McDonald

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CHAPTER I

INTRODUCTION

Objectives of the study:

The main purposes of this study are to investigate the relative effectiveness of graphemic and perceptual representations in learning the concepts of foreign-language words and to determine what happens when they are presented in the context of other representations.

Underwood (1952) differentiated between symbolic and perceptual presentations. He stated, "Presenting an object or a picture of an object will here be called a perceptual presentation of a stimulus; presenting the object name will be called a symbolic presentation. Thus, a picture of a fish is perceptual presentation (sic); presenting the word 'fish', a symbolic presentation" (Underwood, 1952, p. 213, italics mine). In this study some subjects will learn the concepts of foreign-language words from presentations of them along with the colors or simple line-drawings that represent the concepts of these words. Another group of subjects will learn the concepts of these foreign-language words as they are presented along with their English equivalents in printed form. These English words in printed form to be presented to the latter group are called graphemic representations, while the colors and line-drawings of objects to be presented to the former group are called perceptual representations.

The first major objective of the experiment is to determine the relative effectiveness of the graphemic and perceptual representations in learning the concepts of foreign-language words.

These representations may be presented singly along with a foreign-language word as a paired-associate or with one or more other representations with an arrow (or in some other appropriate way) indicating which representation is associated with the word. The representations which are not the proper representation constitute the discriminative context. When red is presented with yellow and blue with a foreign-language word for red, yellow and blue constitute the context for the proper representation, red. The second major objective of this study is to determine the influence of the discriminative context in learning the concepts of foreign-language words.

The need for the study:

Kunihira (1966) found that the development of listening proficiency for a second language was facilitated when the learner was required to respond physically upon hearing utterances in the foreign-language. In that study a subject in the experimental group observed a model and physically responded as the model did when he heard Japanese utterances. For instance, when he heard the Japanese command, "Aruke" meaning "walk", the model and the subject walked together. Other commands were "Maware" (turn), "Tomare" (stop), "Tobe" (jump), "Hashire" (run), and "Suware" (sit). In three short training sessions or within 27 minutes of total training time the morphological and syntactical complexity was increased to the level illustrated by the following examples:

> Tsukue ni aruite itte enpitus to hon o oke.
> (Walk to the desk and put down the pencil and book.)
> Mado ni hashitte itte hon o motte tsukue ni oite isu ni suware.
> (Run to the window, pick up the book, put it on the desk, and sit on the chair.)

The experimental group, who responded physically to the Japanese utterance, was compared for listening comprehension of Japanese utterances with three control groups who learned by more traditional methods. One control group sat and observed the model execute the physical movements when they heard a Japanese utterance. Another control group simulated a traditional method for listening comprehension in which the learner hears an utterance in a foreign language and then hears its English translation. The last control group simulated a traditional method in which the student learns the meaning of a foreign-language utterance by reading its English translation. The subjects in this group read the English translation in a booklet as they heard a Japanese utterance.

The first control group was different from the experimental group mainly in that it did not emit an overt physical response to a given utterance in Japanese. Furthermore, the subjects in this group observed the model approach the door, window, desk, and chair, and pick up and put down different objects; but their perceptual experience with these objects was different in that they themselves did not approach or handle these objects. The second and third control groups were different from the experimental group and the first control group in that they were trained in a room where these objects were not displayed nor was their attention called to them deliberately even when they were present in the room (e.g., doors, windows, desks, chairs, etc.).

The listening comprehension of the experimental group was extremely high and significantly better than that of the control groups, especially when it was measured two weeks after training. The experimental procedure for second-language learning demonstrated its greatest power for the learning of complex Japanese as exemplified in long utterances and novel utterances, when a novel utterance was a new arrangement of structural components the subjects had already learned. Although the structures of the Japanese utterances used were grammatically simple, in that there were only equivalents of subjects, predicates, prepositional phrases, the word order of Japanese is quite different from that of English and the occurrence of particles is unknown in English. Understanding these long and novel utterances means that the experimental subjects not only recognized the key words in a long or novel utterance and understood their meanings but also must have developed some understanding of the linguistic structure of the Japanese language.

However, the study did not clearly indicate the factor or factors that contributed to the stronger retention of the understanding of Japanese utterances as shown by the experimental subjects. Although the physical movements made by them were considered to be the main variable, there were other variables which were not fully controlled in the experimental procedure.

For instance, the perceptual experience with the objects used in training was quite different among the experimental and the control groups. It is probable that the experimental subjects had the advantage of stronger motivation because of the novelty of the learning method and their active participation in the training procedure (e.g., by running and jumping with the instructor). They also had the advantage of close proximity to the instructor as compared to the first control group which watched him from a distance and the other two control groups which merely heard the instructor's voice.

It is also possible that the experimental subjects who executed physical movements with the instructor could have received reinforcement which the instructor inadvertently gave out (e.g., by a slight nod of his head or a look of approval) when the subjects responded correctly. On the other hand, the experimental subjects who emitted a wrong response after hearing a Japanese utterance (because they were encouraged to emit the response without waiting for the instructor's performance as soon as possible during training) might not have had sufficient time to do so. Or, they may have simply failed to emit a correct response with equal force to counteract the wrong response habit learned in the first emission of a wrong response. Even when the subject did correct a wrong response emitted first, the Japanese utterance was not repeated before this corrected response. It must be admitted that the contiguous relationship between the utterance and the corrected response was very weak, if it existed at all.

In order to determine more precisely the influence of physical response in verbal learning, a series of experiments must be designed to evaluate the relative effectiveness of the several variables uncontrolled in the experiment described above and of others which may have influence in the development of listening comprehension.

One of the variables which deserves careful analysis and evaluation is the perceptual experience of the experimental subjects during training. Was their stronger retention of listening comprehension of Japanese utterances partly due to direct perceptual and sensory experience with various objects used in training? Furthermore, the experimental subjects were placed in a situation where they were required to choose from among many objects when they heard the Japanese name for an object (e.g., whether to pick up a book, pencil, or paper). In addition to this choice-making experience, they were required to approach (e.g., to a door) or approach and pick up (e.g., a book on the desk in the opposite corner of the room). In other words, these subjects received direct perceptual and sensory as well as kinesthetic confirmation of the correct choice they made (which they did because they were more carefully following the model in these complex situations).

As indicated in a previous study (Kunihira, 1966), if the subject develops superior listening comprehension when he chooses from among several objects and picks up the proper object upon hearing the foreign-language name for the object instead of just watching the model perform the operation, or listening to or reading the English equivalent; it is necessary to determine whether the effect is due to the psychological process of choosing the proper object from among several alternatives, or to the physical response of picking up the proper object, or to their interaction. Again, the psychological process of choosing the proper object from among several alternatives may be separately appraised by evaluating

1. the influence of the perceptual context provided by the irrelevant alternatives (here called the discriminative context), and
2. the influence of making a choice from among several alternatives.

The influence of the discriminative context may be determined by comparing the relative effect on learning the foreign-language name for an object when it is presented alone and when it is presented in the context of other objects. The influence of making a choice may be studied by comparing the relative effect on learning the foreign-language name for an object when the subject is required to choose a proper object from among several alternatives and when he is given an array of the same objects with the proper object indicated by an appropriate means. The scope of the present study is limited to providing information on the effect of discriminative context when the proper object is indicated (or when choice-making is not involved).

Review of literature:

A review of literature indicates that there is a lack of basic research and consensus on the psychological processes involved in this learning. Early studies yielded conflicting results on the relative effectiveness of graphemic and perceptual representations. For instance, three studies reported by Huse (1931) reached different conclusions. One, a study by Peterson in 1903, found that nonsense syllables were better recalled when they had been associated with object stimuli than with words. A second, by Schlueter in 1914, corroborated the above findings but obtained better *learning* scores for nonsense responses paired with words. A third study, by Netschajeff in 1908, indicated that nonsense responses were both learned faster and retained longer when they had been associated with words rather than with objects.

Carroll (1963, p. 1077) states that "most of the evidence has favored pairing with pictures and the like." After listing several early studies on this problem, he declares, "Many of the other studies are limited in design and should be repeated." Many of these studies were carried out in an actual classroom language-learning situation without adequate control on the characteristics and the manner of presentation of the materials.

Another source of difficulties seems to be that these workers in verbal learning experiments have not tested their hypotheses in simpler language-learning situations. For instance, Wimer and Lambert (1959) employed nine object stimuli, some of which were objects with multiple cues (e.g., a gold-colored ring with green stone). The present study proposes to test the hypothesis with two different categories of simpler perceptual representations.

A review of literature also indicates that information directly related to the function of the discriminative context in verbal learning is almost nonexistent. Experiments in paired-associate learning are not relevant to the present problem. The paired-associate paradigm that has been traditionally employed involves association of a single stimulus item with a single response item in each pair (e.g., A -- m, B -- n, C -- o, etc.). The paradigm of the learning task involved in this study calls for association of a stimulus item with one of three response items presented simultaneously with the proper response item being indicated (e.g., A -- $\overset{\downarrow}{m}$, n, o; B -- x, y, $\overset{\downarrow}{z}$; C -- p, $\overset{\downarrow}{q}$, r; etc.). The investigator has not come across any study in paired-associate learning that employs the latter paradigm.

One might generalize from experiments in concept formation except that the instances and non-instances of a concept are presented sequentially and not simultaneously (Smoke, 1933; Hovland, 1952; Archer, 1962; Huttenlocker, 1962). Spiker and his colleagues (Spiker, 1963) and Kendler and his colleagues (Kendler, 1963) presented subjects with two visual stimuli simultaneously, but the problems they were concerned with are not directly relevant to the present problem. Spiker and his group were interested in verbal influence in discrimination learning, while Kendler and his group were concerned with the problem of reversal shift.

On the general problem of selecting a proper response from simultaneously presented alternatives, programmed learning literature might be helpful. Skinner (1961) and the writers in the field of programmed learning who use Skinner's theory usually regard the contextual stimuli as distracting (for example, they prefer constructive-answer responding to multiple-choice responding). However, Coulson and Silberman (1959) found that multiple-choice responding took significantly less time than constructing responses but found no significant over-all differences using either multiple-choice or constructive-response criterion tests. But, Fry (1960) reported that constructive-responding in training produced significantly better results than multiple-choice responding when the subjects learned 16 English-Spanish paired associates. Zeaman (1958) found that in teaching retarded children better results were obtained with multiple-choice responding when only two choices were provided than when three or more were used.

This meager evidence is at best very inconclusive. Schram (1964, p. 8) declares, "On the question of whether students should write out their response, rather than merely 'thinking' it or selecting one from a multiple choice of answers, the evidence is not clear." This study (which attempts to determine the relative effectiveness of graphemic and perceptual representations in learning the concepts of foreign-language words with simultaneous presentation of representations) should shed some new light on the psychological processes involved in verbal learning.

Hypotheses:

The results of the investigator's previous study (1966) and most of the other studies cited in the previous section suggest that perceptual representations should be more effective in training for listening comprehension of foreign-language words than graphemic representations of their English equivalents. Hypothesis 1 predicts this expectation.

The observations made during the pilot studies indicated that subjects who heard utterances in a foreign-language and physically responded to them in training were also able to understand the utterances when they were required to read the utterances presented in Romanized spelling. No direct test has been made to determine the relative effectiveness of perceptual and graphemic representations in developing this reading comprehension (ability to understand the graphemic representations) of foreign-language words. However, generalization from Hypothesis 1 suggests the superior effectiveness of perceptual representations. Therefore, Hypothesis 2 predicts this expectation.

The prediction made in Hypothesis 3 is based on generalization from a recent pilot study in which children in the 5th and

6th grades showed superior understanding of Japanese names for seven different colors when the colors (in perceptual representations) were presented in the context of other colors (one or two) than when they were presented singly. The study also indicated that a context of two colors resulted in better retention of the concepts of Japanese words than a context of one color. However, the present study is different from the pilot study in that it involves line-drawings besides colors.

The prediction made in Hypothesis 4 is based on the expectation that when a word is presented in the context of other words the context would be distracting as Skinner predicted. However, this prediction is a tentative one because the direction of the relation may be a function of the age of children, the size of words, the abstractness and complexity of concepts involved, etc. The following hypotheses are proposed for testing:

Hypothesis 1. Subjects, who during training hear a foreign-language word along with a perceptual representation of its English equivalent, will be superior to subjects who hear the foreign-language word along with a graphemic representation of its English equivalent on a test that requires them (1) to recognize the perceptual representation of the foreign-language word, (2) to recognize the English equivalent, (3) to write the English equivalent.

Hypothesis 2. Subjects, who during training hear a foreign-language word along with a perceptual representation of its English equivalent, will be superior to subjects who hear the foreign-language word along with a graphemic representation of its English equivalent on a test that requires them to *read the Romanized orthographic representation* of the foreign-language word and then to choose its English equivalent.

Hypothesis 3. Given subjects in training hear a foreign-language word along with a *perceptual representation* of its English equivalent *presented simultaneously* with two (*Condition 2*) or none (*Condition 1*) of the other perceptual representations with the correct representation always indicated; then the subjects in *Condition 2 will be superior* to those in Condition 1 on a test that requires them (1) to recognize the perceptual representation of the foreign-language word, (2) to recognize the English equivalent, and (3) to write the English equivalent.

Hypothesis 4. Given subjects in training hear a foreign-language word along with a *graphemic representation* of its English equivalent *presented simultaneously* with two (*Condition 2*) or none (*Condition 1*) of the other graphemic representations with the correct representation always indicated; then the subjects in *Condition 1 will be superior* to those in Condition 2 on a test that requires them (1) to recognize the perceptual representation of the foreign-language word, (2) to recognize the English equivalent, and (3) to write the English equivalent.

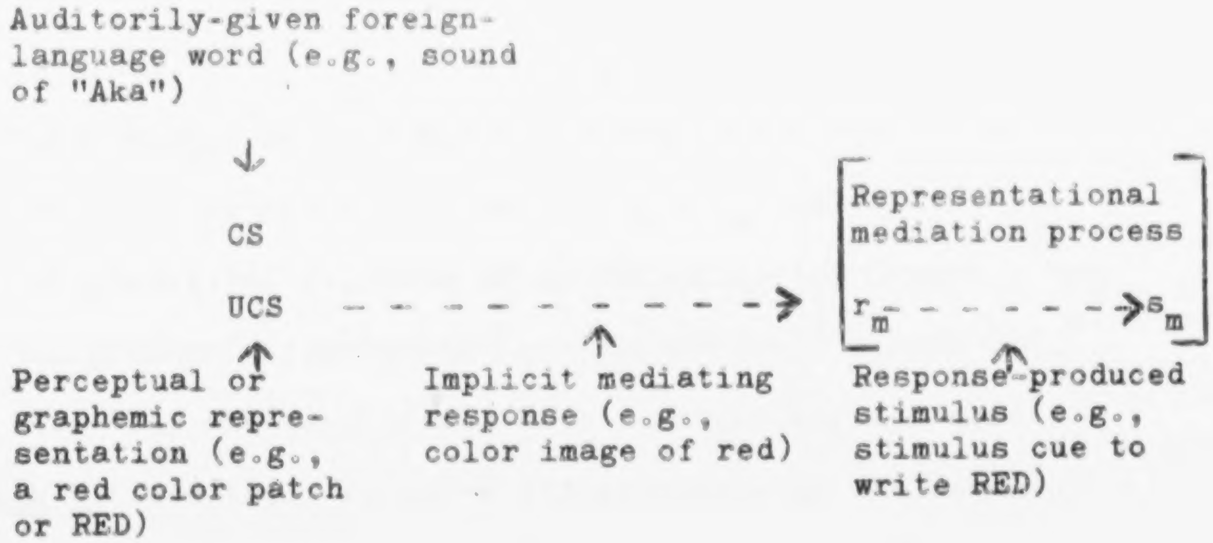
Training and test paradigms:

The type of learning involved in this study is essentially multiple-response learning (Underwood, 1949, p. 384) which consists of "*an integration of a series of discrete responses to discrete stimuli.*" The design of the study utilizes modified forms of paired associate lists. Traditionally, in paired-associate studies both the stimulus and the response terms are presented to the subject in printed form either simultaneously (e.g., on a flash card) or sequentially (e.g., on a memory drum). However, in this study the subject hears the stimulus term (a foreign-language word) and at the same time sees the response term (a perceptual or graphemic representation with or without discriminative context).

The design of the present study is similar to the paired-associate study in which one of the terms is a nonsense syllable and the other a meaningful term. In the training procedure proposed in this study the subject hears a foreign-language word (which is meaningless before training) and learns to associate it with a meaningful term (a color, a line-drawing of a well-known object, a geometric figure, or an English word). The foreign-language word, which is a nonsense term before training and elicits merely an attending response in the subject when he hears it, becomes meaningful and tends to elicit a response similar, if not identical, to that which is elicited by the perceptual or graphemic representation with which it is associated. For example, the Japanese word, aka, after becoming associated with red color, tends to elicit a response to say or write RED when the subject hears aka again.

The process of learning involved is essentially that of learning a second language in the classroom situation which Ervin and Osgood (1965, pp. 139-142) call "a compound language system" in their theory of bilingualism. By adopting their schematic representation of the development of compound bilingualism, the learning process involved in this study may be described as follows:

Paradigm of training:


Auditorily-given foreign-language word (e.g., sound of "Aka")
CS
UCS
Representational mediation process
r_m
s_m
Perceptual or graphemic representation (e.g., a red color patch or RED)
Implicit mediating response (e.g., color image of red)
Response-produced stimulus (e.g., stimulus cue to write RED)

It is assumed that the subject has in his repertoire of learning prior to the training in this study the chain of UCS $\dashrightarrow r_m \dashrightarrow s_m$. In other words, when he reads the English word, RED (i.e., a graphemic representation of red), the experience elicits within him a representational process. This representational process is said to consist of the implicit mediating response (r_m), which may be a color image of red, and the response-produced stimulus (s_m), which may be a stimulus cue to say "red" or write RED or even to elicit an emotional response associated with red.

In training, the subject listens to a foreign-language word along with a perceptual or graphemic representation of the concept of the foreign-language word. By the principle of contiguity the foreign-language word becomes a conditioned stimulus

(CS) by being associated with the conditioned response (CR), which in this case is the implicit mediating response. Thus, by conditioning, a new chain of CS $\dashrightarrow r_m \dashrightarrow s_m$ is formed. For instance, when the subject hears "aka" (CS), the color image of red as an implicit mediating response (r_m) is elicited within him, and it in turn gives rise to a response-produced stimulus cue (s_m).

Hypotheses 1 and 2 compare the relative effectiveness of the representational mediation chains ($r_m \dashrightarrow s_m$) which are elicited by the perceptual representation (Experimental Groups I and II) and the graphemic representation (Experimental Groups III and IV) when they are conditioned to a foreign-language word. Hypothesis 1 tests their relative effectiveness in the development of listening comprehension. Hypothesis 2 tests their relative effectiveness in the development of "reading" comprehension as defined in this study (see page 43).

In testing Hypothesis 1, the foreign-language word, which has been conditioned to the representational mediation chain ($r_m \rightarrow s_m$) by training, should elicit the implicit mediating response (r_m) and the response-produced stimulus (s_m) upon hearing the foreign-language word. The response-produced stimulus in turn functions as a cue enabling the subject to choose the correct representation, either perceptual or graphemic, and to write the graphemic representation. For example, after the subject hears a foreign-language word "aka" along with its perceptual representation (or a patch of red color) in training, he will be required to choose the red color or the English word RED out of four alternatives and to write the English word RED in testing.

In testing *Hypothesis 2*, the subject will be required to read the orthographic representation of the foreign-language word (e.g., Romanized spelling of the Japanese word) and then choose its English equivalent out of three alternatives. For example, when the subject is required to read the Japanese word "aka" in Romanized spelling, the similarity of his pronunciation and the sound he heard in training should elicit the representational mediation chain $(r_m \dashrightarrow s_m)$ which has been conditioned to the foreign-language word. Since the response-produced stimulus (s_m) in this case functions as a cue to say or write RED, it should enable the subject to choose the English word RED when he reads "aka".

The training and test paradigms involved in *Hypotheses 3* and *4* are essentially the same as for *Hypothesis 1*, which have been described above. *Hypotheses 3* and *4* are concerned with the relative effectiveness of the discriminative context in the development of *listening comprehension*.

CHAPTER II

METHOD OF INVESTIGATION

To test the hypotheses, *four* treatment groups designated as *Experimental Groups I*, *II*, *III*, and *IV* were trained for listening comprehension of 12 Japanese names for colors and objects and then tested for understanding of these Japanese words immediately after training and one week later.

Subjects:

The subjects were 136 sixth-grade public school children in the Palo Alto, California area. The area has a predominantly middle-class white population with more than average education. The *School and College Ability Test* (SCAT) scores were available for all the children participating in the experiment.

The subjects were trained in groups of 20 to 30 children and were randomly assigned to the four experimental groups by randomly distributing an equal number of four different kinds of training booklets. There were 34 subjects in each treatment group. Male and female subjects were not assigned in equal numbers to each group. It was assumed that sex differences would not be significantly related to verbal learning at the simple level studied in this experiment.

I. GENERAL PROCEDURE

The experiment was so designed that training under four different treatments could be conducted in the same setting and while at the same time randomly assigning subjects to four groups. The following general procedure applied to all groups.

Familiarization procedure:

When subjects were seated in a classroom, the Exercise Sheets (Appendix A) were distributed. The Exercise Sheets consisted of two pages, each page presenting six English words in the left column to be matched with six colors and line-drawings of objects in the right column. The subjects were asked to complete the task in five minutes after the following instructions:

> You are going to learn 12 Japanese names for colors and objects. The Exercise Sheets will show you these colors and objects and what they are in English.
>
> In order to make sure that you can name the colors and objects in English we want you to draw a line between each English word and the color or object it represents, for instance, the word 'red' and the red color.
>
> After you connect all the English words and the colors and objects, we want you to write the English words under the colors and objects in order to make sure that you know how to spell these words.
>
> Now you may work on the Exercise Sheets. There are two pages. You have five minutes to complete them.

Training for listening comprehension:

When the Exercise Sheets were gathered, the Language Training Booklets were distributed. There were four different kinds of booklets, one for each treatment group. The training booklet for Experimental Group I presented in each page a color or a line-drawing of an object, while the subjects in Experimental Group II saw in each page three colors and line-drawings with an arrow indicating one of them as the proper perceptual representation of the Japanese name they heard. The training booklets for Experimental Groups III and IV were different only in that they presented English words in printed form (graphemic representations) instead of colors and line-drawings of objects (perceptual representations). The subjects in Experimental Group III saw one English word on each page, while the subjects in Experimental Group IV saw three words with one of them indicated by an arrow.

An equal number of these four different kinds of training booklets were distributed randomly, thus assigning the subjects randomly to four groups. Before training began the following instructions were given:

> You have before you the Language Training Booklets for 12 Japanese words. When I play the tape recorder, it will tell you when to turn each page by calling the page number.
>
> On each page some of you will see a color, a picture, or a word. The others will see three color pictures, or words with the correct one indicated by an arrow. You must pay close attention to the color, the picture, or the word as you listen to the Japanese word for it. The Japanese word will be repeated three times. When the tape recorder calls the next page, immediately turn to the page. Be sure that the page number on the right top corner of each page and the number called by the tape recorder are the same.

Then, the experimenter played the tape recorder which reproduced the voice of a native speaker who pronounced the Japanese word for each page of the training booklet three times at an interval of 5 seconds. After the third calling of the Japanese word, the tape recorder instructed the subjects to turn to the next page. Five seconds were allowed for this.

The training booklet presented each of the 12 Japanese words four times in a random order. There were 48 pages in a booklet, and it took about 20 minutes to complete the training.

Immediate retention test

Upon the completion of the training, the Exercise Sheets for Japanese (Appendix C) were distributed, and the subjects were asked to copy the serial numbers of the training booklets and to write their names on the cover sheets of the Exercise Sheets. Then, the following instructions were given:

> We want you to show if you can recognize colors, objects or English words when you hear the Japanese words you heard in training. So, there will be exercises for you to choose one color or one picture or one English word out of four.
>
> We also want to know if you can write the English word when you hear a Japanese word. When you see a blank after the number called, we want you to write the English word.
>
> The tape recorder will call out the page number and the number for each exercise and then it will pronounce the Japanese word twice. As soon as you hear the Japanese word and understand it, check one of four colors, pictures, or English words which you think is the meaning of the Japanese word. If you see a blank after the number, write the English words.

The Exercise Sheets for Japanese consisted of two parts. The first six pages constituted the first section which the subjects were tested for their ability to recall the meaning of the

Japanese word when they heard it. In this section there were 12 items in which the subjects were required to choose one out of four perceptual representations (i.e., colors and pictures), 12 items to choose one out of four graphemic representations (i.e., English words), and 12 items to write English words.

These three different kinds of measure for the retention of the meanings of the Japanese words, in all 36 items, were randomly arranged. Each page of the exercise sheets presented six items with a constraint that the same Japanese word was called out by the tape recorder only once for each page.

The tape recorder called out the number of each exercise and then pronounced the Japanese word twice with a five-second pause between. Ten seconds were allowed after the second calling of the Japanese word for the response. Then, the tape recorder called out the number of the next item and five seconds passed before the next Japanese word was pronounced. The first section of the retention test took about 12 minutes.

The second part of the test measured the subjects' ability to read the orthographic representations (in Romanized spelling) of the Japanese words and to understand their meanings. It consisted of 12 exercises. In the left column, 12 Japanese words were printed in Romanized spelling. After each Japanese word there were three English words, one being the correct translation. The subjects were asked to check the correct English word. They were given five minutes to complete the task.

One-week retention test:

A week later the experimenter returned to the same classroom and administered the second retention test (Appendix D) similar to the first retention measure. The only difference was that the order of items had been randomly rearranged.

Schedule of training and retention measure:

Table 1 shows the type of training for the four experimental groups and the schedule of retention tests.

TABLE 1

TRAINING AND RETENTION TESTS

Groups Events	Experimental Group I	Experimental Group II	Experimental Group III	Experimental Group IV
Familiarization procedure	The Exercise Sheets (identical for all groups)			
Training	The Language Training Booklet			
	1 perceptual representations per page	3 perceptual representations per page	1 graphemic representations per page	3 graphemic representations per page page
Immediate retention test	The Exercise Sheets for Japanese (A) (identical for all groups)			
one-week retention test	The Exercise Sheets for Japanese (B) (identical for all groups)			

II. CONSTRUCTION OF THE FAMILIARIZATION EXERCISE SHEETS

In order to familiarize the subjects with the perceptual and graphemic representations used in the training booklets and the retention tests, they were given an experience to match the graphemic representations and the perceptual representations before the training began. Since the subjects would be asked to write the English words for the Japanese words they heard in the retention tests, they were given an opportunity to write the English words under the perceptual representations during the familiarization procedure.

The Exercise Sheets used for this purpose presented randomly ordered graphemic and perceptual representations, the graphemic in the left column and the perceptual in the right column (Appendix A). The Exercise Sheets contained two pages beside the cover, each page presenting six pairs of representations. There was ample space below each perceptual representation for the subjects to write the English word for it.

III. CONSTRUCTION OF THE TRAINING BOOKLET

The Language Training Booklet was constructed of 50 sheets of 5" x 7 1/2" white index paper bound with 1/2" plastic binding. The two outside sheets served as covers.

Perceptual and graphemic representations

Black line-drawings of a circle, square, star, window, flower, and chair were professionally done and printed by an offset process on white paper with gummed backing. The dimensions of the drawings were about 1" at the widest points. Color paper with gummed backing in red, orange, yellow, green, blue, and black was cut into 1" x 1/2" pieces. These line-drawings and color pieces were pasted on the training booklet as perceptual representations.

The 12 English words for these colors and line-drawings were typed on a white sheet of paper with executive type and then photographically enlarged to sizes comparable to the color pieces and printed on white paper with gummed backing by an offset process.

Choice of words:

The 12 Japanese words selected for training purposes were two-syllable words except one color name (i.e., midori) and one figure name (i.e, shikaku) as shown in Table 2. The table also presents the frequency ratings given by Thorndike and Lorge (1944) for the English equivalents of the 12 Japanese words. All of these English words rated very high in the frequency of occurrence in the general reading matters and in the juvenile books surveyed by Thorndike and Lorge.

TABLE 2

JAPANESE AND ENGLISH WORDS AND THEIR FREQUENCY RATINGS

Japanese Words	English Words	G*	J**
aka	red	AA	M
mikan	orange	A	291
keyro	yellow	AA	526
midori	green	AA	M
awo	blue	AA	M
kuro	black	AA	M
hana	flower	AA	M
isu	chair	AA	700
mado	window	AA	M
maru	circle	AA	379
hoshi	star	AA	700
shikaku	square	AA	626

*G: the frequency of occurrence of the word in general
AA = 100 or over per million
A = at least 50 per million

**J: the Thorndike count of 120 juvenile books
M = 1,000 times or more in the count of 120 juvenile books

__Word list for Condition 1:__

Experimental Groups I and III were trained in Condition 1 in which a single perceptual representation (for Experimental Group I) or a single graphemic representation (for Experimental Group III) was presented in each page of the training booklet.

Four random lists of the 12 words used in the experiment were combined to make a list of 48 words (Appendix B). The subjects who were trained in Condition 1 saw each of the 12 perceptual or graphemic representations four times in a random order. The training booklet for Experimental Group I was prepared by pasting on each page a perceptual representation according to the word list for Condition 1. The training booklet for Experimental Group III was likewise constructed by pasting the graphemic representations.

Word list for Condition 2:

Experimental Groups II and IV were trained in Condition 2 in which three perceptual (for Experimental Group II) or three graphemic representations (for Experimental Group IV) were presented in each page of the training booklet with one of the representations indicated with an arrow.

The word list for Condition 2 (Appendix B) was prepared by combining two additional random lists of 48 words (each of the 12 words appearing four times) on either side of the original word list prepared for Condition 1 with the constraint that three words in each set were different from each other. In each set of words the position of the word of the original list was randomly determined. For instance, the word "red" in the original word list for Condition 1 may be placed in three different positions when it acquires two additional words to form a set as: (1) red, blue, chair; (2) blue, red, chair; or (3) blue, chair, red.

The training booklet for Experimental Group I was prepared by pasting on each page the perceptual representations according to the word list for Condition 2. The training booklet for Experimental Group IV was likewise constructed by pasting the graphemic representations.

IV. CONSTRUCTION OF THE RETENTION TESTS

Two parallel retention tests were constructed, one to be administered immediately after training and another one week later. They were parallel tests in that the items in the first test were randomly reordered for the second test (Appendices C and D).

Each test consisted of two parts, the first section to measure the listening comprehension of the Japanese words and the second section to measure reading comprehension of the Japanese words presented in Romanized spelling.

The first section of the test contained 36 items. In 12 items the subjects were required to choose a perceptual representation (a color or a line-drawing) from among four alternatives. In 12 other items the subjects had to choose an English word out of four alternatives. Each of these two sets of 12 multiple-choice items was constructed by combining four random lists of the 12 representations with the constraint that all representations in each test item were different. The remaining 12 items required the subjects to write English words. These 36 items were randomly ordered and presented in six pages (or six items per page) with the constraint that a Japanese word was pronounced only once per page.

The tape recorder provided the stimulus. A recorded voice pronounced the Japanese word for each test item twice at an interval of five seconds, and 10 seconds were allowed after the second calling of the Japanese word for the response. Then, the tape recorder called out the number of the next item and five seconds passed before the next Japanese word was pronounced. Twelve minutes were required for the administration of the first section of the test.

The second part of the retention test was constructed with a randomly ordered list of the 12 Japanese words in Romanized spelling printed in a column on the left and three English words for each Japanese word printed to the right of it. A list of English words corresponding to the list of Japanese words was combined with two other random lists of the 12 English words to provide two alternatives for each English word to be chosen.

CHAPTER III

RESULTS

I. LISTENING COMPREHENSION

One of the primary objectives of the study was to compare the listening comprehension of Japanese words when subjects were trained under four different conditions. The first section of the retention test which measured listening comprehension may be subdivided into the following measures:

"Perceptual" choice. When the subject heard a Japanese word, he chose a perceptual representation (a color or a line-drawing) out of four alternatives as the proper representation of the concept of the Japanese word. The maximum possible score was 12.

(1) "Color" choice. Six of the perceptual representations were colors (i.e., red, orange, yellow, green, blue, and black). The maximum possible score for "color" choice was six.

(2) "Figure choice. The remaining six of the perceptual representations were line-drawings of three geometric figures (i.e., circle, square, and star) and three objects (i.e., window, chair, and flower). The maximum possible score for "figure" choice was six.

"Graphemic" choice. When the subject heard a Japanese word, he chose a graphemic representation (the English name for a color, a geometric figure, or an object) out of four alternatives as the proper equivalent of the Japanese word. The maximum possible score was 12.

(1) "Color" name. Six of the graphemic representations were the names of colors. The maximum possible score for "color" name was six.

(2) "Figure" name. The remaining six of the graphemic representations were the names for three geometric figures and three objects. The maximum possible score for "figure" name was six.

"Writing". When the subject heard a Japanese word, he wrote the English word which he believed to be the equivalent of the Japanese word. There were six color names and six names for geometric figures and objects. The maximum possible score was 12.

(1) "Color" name. There were six color names to write. The maximum possible score for "color" name writing was six.

(2) "Figure" name. The remaining six were the names for geometric figures and objects. The maximum possible score for "figure" name writing was six.

Table 3 presents these three kinds of measure of listening comprehension and their submeasures with their respective maximum possible scores.

TABLE 3

MEASURES OF LISTENING COMPREHENSION

Measure	Description	Maximum Score	
"Perceptual" Choice	Choice of a color or a line-drawing out of four alternatives		12
(1) "Color" Choice	Choice of a color name	6	
(2) "Figure" Choice	Choice of a line-drawing	6	
"Graphemic" Choice	Choice of an English name for a color or a line-drawing out of four alternatives		12
(1) "Color" Name	Choice of an English name for a color	6	
(2) "Figure" Name	Choice of an English name for a line-drawing	6	
"Writing"	Writing an English name for a color or a line-drawing		12
(1) "Color" Name	Writing an English name for a color	6	
(2) "Figure" Name	Writing an English name for a line-drawing	6	

Tables 4 and 5 present the means and standard deviations of the scores for listening comprehension by different kinds of measures in the immediate and the one-week retention tests. Observation of these tables indicated that Experimental Group I, which was trained with a single perceptual representation in each page of the training booklet, obtained the highest mean on every measure of listening comprehension in both the immediate and the one-week retention tests. It was also observed that Experimental Group IV, which saw three graphemic representations with the relevant one indicated by an arrow in each page of the training booklet, tended to be the lowest on every measure of listening comprehension. However, it was noticed that the differences among Experimental Groups II, III, and IV were not large. There was no observable trend in variance. The standard deviations for the four experimental groups in each measure clustered closely around their mean.

TABLE 4

LISTENING COMPREHENSION ON THE IMMEDIATE RETENTION TEST

Group	I		II		III		IV	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
"Perceptual" Choice	8.97	2.18	8.44	2.35	7.88	2.85	7.71	2.60
"Color" Choice	4.35	1.50	4.06	1.43	3.71	1.80	3.74	1.56
"Figure" Choice	4.62	1.21	4.38	1.18	4.18	1.45	3.97	1.45
"Graphemic" Choice	9.15	2.61	8.50	2.40	7.88	2.58	7.82	2.66
"Color" Name	4.38	1.58	4.18	1.40	4.03	1.66	3.97	1.36
"Figure" Name	4.76	1.30	4.32	1.34	3.85	1.33	3.85	1.64
"Writing"	6.79	3.45	5.29	2.66	5.68	2.90	5.76	3.38
"Color" Name	3.24	1.83	2.74	1.48	2.74	1.80	2.91	1.83
"Figure" Name	3.56	1.83	2.56	1.56	2.94	1.54	2.85	1.96

TABLE 5

LISTENING COMPREHENSION ON THE ONE-WEEK RETENTION TEST

Group	I		II		III		IV	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
"Perceptual" Choice	9.24	2.19	8.68	2.92	8.76	2.59	8.06	2.73
"Color" Choice	4.44	1.46	4.18	1.71	4.12	1.77	3.97	1.64
"Figure" Choice	4.79	1.09	4.50	1.52	4.65	1.20	4.09	1.38
"Graphemic" Choice	9.29	2.53	8.62	2.74	8.68	2.37	8.50	2.30
"Color" Name	4.44	1.58	4.15	1.50	3.85	1.54	4.21	1.47
"Figure" Name	4.85	1.16	4.47	1.42	4.82	1.19	4.29	1.09
"Writing"	7.79	3.24	6.91	2.98	6.56	3.39	6.06	3.54
"Color" Name	3.82	1.82	3.47	1.67	2.97	2.12	3.24	1.76
"Figure" Name	3.97	1.68	3.44	1.69	3.59	1.54	2.82	1.98

Hypothesis 1 predicted the relative effectiveness of perceptual and graphemic representations in developing listening comprehension of foreign language words. It called for the comparison between Experimental Group I (a single perceptual representation in each page of the training booklet) and Experimental Group III (a single graphemic representation) as well as between Experimental Groups I and II combined (perceptual representations) and Experimental Groups III and IV combined (graphemic representations).

The test of Hypotheses 3 and 4 required a comparison between Experimental Groups I and II and between III and IV in order to determine the influence of discriminative context on listening comprehension developed by the two different kinds of representations, namely, perceptual and graphemic.

The two experimental variables (i.e., mode of representation and presence of discriminative context) were orthogonal in that they were not correlated in any way. Each of these independent variables was presented in two levels (i.e., perceptual-graphemic, without context-with context). The experimental design was a typical 2 x 2 factorial design with two levels in the row and in the column as shown in Table 6.

TABLE 6

SCHEMATIC REPRESENTATION OF EXPERIMENTAL DESIGN

	Perceptual Representation	Graphemic Representation
Without Context	Experimental Group I $N_1 = 34$	Experimental Group III $N_3 = 34$
With Context	Experimental Group II $N_2 = 34$	Experimental Group IV $N_4 = 34$

Analysis of variance with two-way classification (McNemar, 1962, p. 303) would permit the testing of column effects (i.e., perceptual vs. graphemic) which was called for by Hypothesis 1. It would also provide the interaction sum of squares to determine the presence of interaction. The presence of interaction might be taken as partial evidence to support Hypotheses 3 and 4.

Comparison of Experimental Groups I and III (Hypothesis 1) is a within-row comparison. Comparison of Experimental Groups I and II (Hypothesis 3) and comparison of Experimental Groups III and IV (Hypothesis 4) are within-column comparisons. These comparisons may be tested for significance by the t-test with the standard error of a comparison based on the error mean square of the analysis of variance, with df equal to the number of degrees of freedom of the error mean square, which in this case was 132 (Edwards, 1960, p. 142).

Homogeniety of mental ability:

Before the comparison was made for listening comprehension among the four treatment groups, the homogeneity of mental ability among the four groups was tested. Table 7 shows the analysis of variance of the School and College Ability Test (SCAT) scores for the subjects in the four treatment groups. The value of F ($df_1 = 3$, $df_2 = 132$) was 0.29, which is not significant. It was concluded that the subjects assigned randomly to the four experimental groups were drawn from a single general population with respect to mental ability measured by SCAT.

TABLE 7

ANALYSIS OF VARIANCE OF THE SCHOOL AND COLLEGE ABILITY TEST (SCAT) SCORES

Source	Sum of Squares	df	Mean Square	F Ratio
Between Groups	104.55	3	34.85	0.29
Within Groups	15979.56	132	121.06	
Total	16084.11	135		

Relative effectiveness of perceptual and graphemic representations:

Tables 8 to 13 present the results of the analysis of variance for the "perceptual" choice, "graphemic" choice, and "writing" measures (which were measures of listening comprehension) in the immediate and the one-week retention tests. The value of F is shown only when the mean square for rows, columns, or interaction is larger than the error mean square.

TABLE 8

ANALYSIS OF VARIANCE OF "PERCEPTUAL" CHOICE SCORES IN THE IMMEDIATE RETENTION TEST

Source of Variation	Sum of Squares	df	Mean Square	F
Rows (Context)	4.2353	1	4.2353	
Columns (Representations)	29.2647	1	28.2647	4.50*
Interaction (Context by representations)	1.0591	1	1.0591	
Within cells	829.9409	132	6.2873	
Total	863.5000	135		

*Significant at P = .05

TABLE 9

ANALYSIS OF VARIANCE OF "GRAPHEMIC" CHOICE SCORES IN THE IMMEDIATE RETENTION TEST

Source of Variation	Sum of Squares	df	Mean Square	F
Context	4,2533	1	4.2353	
Representation	32.0294	1	32.0294	4.87*
Interaction	2.9411	1	2.9411	
Within cells	867.2351	132	6.5670	
Total	906.4409	135		

*Significant at P = .05

TABLE 10

ANALYSIS OF VARIANCE OF "WRITING" SCORES IN THE IMMEDIATE RETENTION TEST

Source of Variation	Sum of Squares	df	Mean Square	F
Context	16.9412	1	16.9412	1.75*
Representations	3.5588	1	3.5588	
Interaction	21.4413	1	21.4414	2.21*
Within cells	1280.1759	132	9.6983	
Total	1322.1172	135		

*Significant at P = .25

TABLE 11

ANALYSIS OF VARIANCE OF "PERCEPTUAL" CHOICE SCORES IN THE ONE-WEEK RETENTION TEST

Source of Variation	Sum of Squares	df	Mean Square	F
Context	15.5588	1	15.5588	2.26*
Representations	9.5294	1	9.5294	1.39*
Interaction	0.2646	1	0.2646	
Within cells	906.8821	132	6.8703	
Total	932.2349	135		

*Significant at P = .25

TABLE 12

ANALYSIS OF VARIANCE OF "GRAPHEMIC" CHOICE SCORES IN THE ONE-WEEK RETENTION TEST

Source of Variation	Sum of Squares	df	Mean Square	F
Context	7.0662	1	7.0662	1.14*
Representations	6.1838	1	6.1838	
Interaction	2.6544	1	2.6544	
Within cells	819.7351	132	6.2101	
Total	835.6395	135		

*Not significant

TABLE 13

ANALYSIS OF VARIANCE OF "WRITING" SCORES IN THE ONE-WEEK RETENTION TEST

Source of Variation	Sum of Squares	df	Mean Square	F
Context	16.2426	1	16.2426	1.50*
Representations	37.0662	1	37.0662	3.42**
Interaction	1.2426	1	1.2426	
Within cells	1430.5583	132	10.8376	
Total	1485.1097	135		

*Significant at P = .25

**Significant at P = .10

Table 14 summarizes the value of F for the column effects. The column effects or the difference in effectiveness between perceptual and graphemic representations in developing listening comprehension, which were significant at the level of P = .05 in the "perceptual" choice and "graphemic" choice measures immediately after training, largely lost their significance one week later. On the other hand, the "writing" measure showed an increase in significance a week later.

TABLE 14

COMPARISON OF VALUES OF F FOR COLUMN EFFECTS ON MEASURES OF LISTENING COMPREHENSION IN THE IMMEDIATE AND ONE-WEEK RETENTION TESTS

Measures	Immediate Retention	One-Week Retention
"Perceptual" Choice	4.50***	1.39*
"Graphemic" Choice	4.87***	NS
"Writing"	2.21*	3.42**

*P = .25

**P = .10

***P = .05

Tables 15 to 17 present the results of the t-tests. The significance of differences was tested between Experimental Groups I and II, between I and III, between III and IV, and between I and II combined and III and IV combined in "perceptual" choice, "graphemic" choice, and "writing", all of which were measures of listening comprehension. Since the hypotheses indicated the direction of prediction in each comparison, the levels of significance were based on the one-tailed test.

TABLE 15

SIGNIFICANCE TEST FOR "PERCEPTUAL" CHOICE

Groups Compared	Mean (First Group)	Mean (Second Group)	s_d*	t	P
Immediate Retention					
I vs. II	8.97	8.44	.608	.87	.20
I vs. III	8.97	7.88	.608	1.79	.05
I and II vs. III and IV	17.41	15.59	.860	2.12	.025
III vs. IV	7.88	7.71	.608	.27	NS
One-week Retention					
I vs. II	9.26	8.68	.636	.92	.20
I vs. III	9.26	8.82	.636	.69	.25
I and II vs. III and IV	17.94	16.88	.899	1.18	.25
III vs. IV	8.82	8.06	.636	2.20	.15

*s_d: standard error of a comparison based on the error mean square of the analysis of variance.

df = 132

TABLE 16

SIGNIFICANCE TEST FOR "GRAPHEMIC" CHOICE

Groups Compared	Mean (First Group)	Mean (Second Group)	s_d*	t	P
Immediate Retention					
I vs. II	9.15	8.50	.621	1.06	.25
I vs. III	9.15	7.88	.621	2.04	.025
I and II vs. III and IV	17.65	15.71	.879	2.21	.025
III vs. IV	7.88	7.82	.621	.95	.20
One-week Retention					
I vs. II	9.38	8.65	.604	1.22	.15
I vs. III	9.38	8.68	.604	1.17	.15
I and II vs. III and IV	18.03	17.18	.854	1.00	.25
III vs. IV	8.68	8.50	.604	.29	NS

*s_d: standard error of a comparison based on the error mean square of the analysis of variance.

df = 132

TABLE 17

SIGNIFICANCE TEST FOR "WRITING"

Groups Compared	Mean (First Group)	Mean (Second Group)	s_d*	t	P
Immediate Retention					
I vs. II	6.79	5.29	.755	1.99	.025
I vs. III	6.79	5.68	.755	1.48	.10
I and II vs. III and IV	12.09	11.44	1.07	.60	NS
III vs. IV	5.68	5.76	.755	-.12	NS
One-week Retention					
I vs. II	7.79	6.91	.798	1.11	.10
I vs. III	7.79	6.56	.798	1.55	.10
I and II vs. III and IV	14.71	12.62	1.13	1.85	.05
III vs. IV	6.56	6.06	.798	.63	NS

*s_d: standard error of a comparison based on the error mean square of the analysis of variance.

df = 132

Summarizing the results of the two-way analyses of variance (Tables 8 to 13) and the t-tests (Tables 15 to 17), it was concluded that perceptual and graphemic representations made significant difference in the development of listening comprehension of the Japanese words used in this experiment when listening comprehension was measured immediately after training. However, the difference became less pronounced a week later, though the groups trained with perceptual representations still maintained higher means in all measures of listening comprehension. Hypothesis I, which predicted the superior effectiveness of perceptual representations, was supported only for immediate effects of training.

None of the interaction mean squares obtained by the two-way analysis of variance (Tables 8 to 13) was large enough to give a significant F. The demonstration of Hypotheses 3 and 4 was unlikely. A further analysis of the data with the t-test testing the significance of difference between Experimental Groups I and II and between III and IV (Tables 15 to 17) showed little difference between them. Observation of the data indicated a trend opposite to the prediction made in Hypothesis 3 (higher means for Experimental Group I than for Group II) and a trend in conformity with the prediction made in Hypothesis 4 (higher means for Experimental Group III than for Group IV). However, it was concluded that Hypothesis 3 and 4 were not statistically confirmed as far as listening comprehension was concerned.

II. READING COMPREHENSION

In the second part of the retention tests the subject read a Japanese word in Romanized spelling and then chose an English word which he believed to be the equivalent of the Japanese word. He did not hear the Japanese word pronouned by the native speaker as he had done in training and in the first part of the retention test. Reading comprehension as it is understood in this study is defined by the operation described above.

As shown in Table 18, the means tended to be higher for reading comprehension than for listening comprehension for all groups in both the immediate and the one-week retention tests. It must be remembered that the scores for reading comprehension and those for listening comprehension are not comparable because the measure for reading comprehension provided only three alternatives to choose from, while the measures for listening comprehension provided four alternatives. However, the indication seems clear that the subjects showed no apparent difficulty when they were asked to indicate understanding of Japanese words without the aid of an auditory stimulus with which they were trained for recognition and understanding of the Japanese words. No significance test of the difference between reading and listening comprehension was attempted because the measures for them were not comparable as has been mentioned.

TABLE 18

MEANS AND STANDARD DEVIATIONS FOR LISTENING AND READING COMPREHENSION IN THE IMMEDIATE AND THE ONE-WEEK RETENTION TESTS

Groups Compared	I		II		III		IV	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
The Immediate Retention Test								
Listening Comprehension								
"Perceptual" Choice	8.97	2.18	8.44	2.35	7.88	2.85	7.71	2.60
"Graphemic" Choice	9.15	2.61	8.50	2.40	7.88	2.58	7.82	2.66
"Writing"	6.79	3.45	5.29	2.66	5.68	2.90	5.76	3.38
Reading Comprehension								
"Reading"	9.56	1.99	8.88	2.11	8.29	2.84	8.09	2.61
The One-Week Retention Test								
Listening Comprehension								
"Perceptual" Choice	9.24	2.19	8.68	2.92	8.76	2.59	8.06	2.73
"Graphemic" Choice	9.29	2.53	8.62	2.74	8.68	2.37	8.50	2.30
"Writing"	7.79	3.24	6.91	2.98	6.56	3.39	6.06	3.54
Reading Comprehension								
"Reading"	10.50	1.96	10.15	2.64	9.24	2.96	8.82	2.98

Table 18 also indicates that Experimental Group I showed uniformly higher means than the other three experimental groups in reading comprehension in both the immediate and the one-week retention tests. The summaries of the analysis of variance and covariance for the immediate and one-week retention tests are presented in Tables 20 to 23.

Table 19 summarizes the values of F for reading comprehension obtained by both the analysis of variance and covariance. The F ratio obtained by the analysis of variance for reading comprehension in the immediate retention test was significant at P = .10, while the F ratio obtained by the analysis of covariance by controlling the variance due to the SCAT scores was significant at P = .05. The F ratio obtained by the analysis of variance for reading comprehension in the one-week retention test was significant at P = .05, while the F ratio obtained by the analysis of covariance was significant at P = .025. For reading comprehension, higher values of F were obtained by controlling the variance due to the SCAT scores, indicating dependence of reading comprehension on mental ability as measured by SCAT.

TABLE 19

COMPARISON OF VALUES OF F BY THE ANALYSIS OF VARIANCE AND COVARIANCE ON THE MEASURE OF READING COMPREHENSION IN THE IMMEDIATE AND ONE-WEEK RETENTION TESTS

Type of Analysis	Immediate Retention	One-Week Retention
Analysis of Variance	2.55*	2.90**
Analysis of Covariance	2.68**	3.23***

*P = .10
**P = .05
***P = .025

TABLE 20

ANALYSIS OF VARIANCE OF SCORES IN READING COMPREHENSION IN THE IMMEDIATE RETENTION TEST

Source	Sum of Squares	df	Mean Square	F Ratio
Between Groups	44.53	3	14.84	2.55*
Within Groups	769.71	132	5.83	
Total	814.24	135		

*Significant at P = .10

TABLE 21

ANALYSIS OF COVARIANCE OF SCORES IN READING COMPREHENSION IN THE IMMEDIATE RETENTION TEST

Source	Sum of Squares	df	Mean Square	F Ratio
Between Groups	42.10	3	14.03	2.68**
Within Groups	686.91	131	5.24	
Total	729.01	134		

**Significant at P = .05

TABLE 22

ANALYSIS OF VARIANCE OF SCORES IN READING COMPREHENSION IN THE ONE-WEEK RETENTION TEST

Source	Sum of Squares	df	Mean Square	F Ratio
Between Groups	61.94	3	20.65	2.98**
Within Groups	939.82	132	7.12	
Total	1001.76	135		

**Significant at P = .05

TABLE 23

ANALYSIS OF COVARIANCE OF SCORES IN READING COMPREHENSION IN THE ONE-WEEK RETENTION TEST

Source	Sum of Squares	df	Mean Square	F Ratio
Between Groups	60.65	3	20.22	3.23***
Within Groups	819.00	131	6.25	
Total	879.65	134		

***Significant at P = .025

Hypothesis 2 called for testing of the relative effectiveness of perceptual and graphemic representations in the development of reading comprehension. Tables 24 and 25 show the summaries of the two-way analysis of variance for reading comprehension as measured immediately after training and one week later. Table 26 presents the results from the t-tests, which tested for significance the differences between Experimental Groups I and III and between I and II combined and III and IV combined.

TABLE 24

ANALYSIS OF VARIANCE OF "READING" SCORES
IN THE IMMEDIATE RETENTION TEST

Source of Variation	Sum of Squares	df	Mean Square	F
Context	6.6176	1	6.6176	1.13
Representations	36.0294	1	36.0294	6.18*
Interaction	1.8824	1	1.8824	
Within cells	769.7056	132	5.8311	
Total	814.2350	135		

*Significant at P = .025

TABLE 25

ANALYSIS OF VARIANCE OF "READING" SCORES IN THE ONE-WEEK RETENTION TEST

Source of Variation	Sum of Squares	df	Mean Square	F
Context	4.9706	1	4.9706	
Representations	56.9412	1	56.9412	7.80*
Interaction	0.0294	1	0.0294	
Within cells	939.8233	132	7.1199	
Total	1001.7645	135		

*Significant at P = .01

TABLE 26

SIGNIFICANCE TEST FOR "READING" COMPREHENSION

Groups Compared	Mean (First Group)	Mean (Second Group)	s_d*	t	P
Immediate Retention					
I vs. III	9.56	8.29	.586	2.16	.025
I and II vs. III and IV	18.44	16.38	.828	2.49	.01
One-Week Retention					
I vs. III	10.50	9.23	.647	1.96	.05
I and II vs. III and IV	20.65	18.06	.915	2.83	.005

*s_d: standard error of a comparison based on the error mean square of the analysis of variance.

df = 132

The results obtained by the two-way analysis of variance (Tables 24 and 25) and by the t-test (Table 26) showed that reading comprehension developed with perceptual representations was significantly superior to reading comprehension developed with graphemic representations both immediately after training and one week later. This phenomenon was in contrast to that of listening comprehension, which showed no significant difference in the relative effectiveness of perceptual and graphemic representations one week after training.

Hypothesis 2 which predicted the superiority of the subjects who were trained with perceptual representations over the subjects who were trained with graphemic representations in reading comprehension was confirmed.

III. COMPREHENSION OF "COLOR" NAMES AND "FIGURE" NAMES

There were 12 Japanese words used in the experiment, six of which were "color" names. The other six were names for three geometric figures and three objects, which were designated as "figure" names.

The retention test contained four different measures of the comprehension of the Japanese words. The first three (i.e., "perceptual" choice, "graphemic" choice, and "writing") constituted the first part. A measure for reading comprehension (i.e., "reading") constituted the second part. Each of these four measures tested the comprehension of six "figure" names. The maximum possible summed score for "figure" names was also 24 as shown in Table 27. These summed measures for "color" names and "figure" names were called "color" comprehension and "figure" comprehension respectively.

TABLE 27

MAXIMUM POSSIBLE SCORES FOR "COLOR" AND "FIGURE" COMPREHENSION

Retention Measure	Submeasure	"Color" Comprehension	"Figure" Comprehension
"Perceptual" Choice (12)			
	"Color" Choice (6)*	6	
	"Figure" Choice (6)		6
"Graphemic" Choice (12)			
	"Color" Name (6)	6	
	"Figure" Name (6)		6
"Writing" (12)	"Color" Name (6)	6	
	"Figure" Name (6)		6
"Reading" (12)			
	"Color" Name (6)	6	
	"Figure" Name (6)		6
Maximum Possible Summed Score		24	24

*The number in ( ) indicates the maximum possible score.

"Color" comprehension:

Table 28 shows that Experimental Group I had the highest means and that little difference existed among the other groups in both the immediate and the one-week retention tests.

TABLE 28

MEANS AND STANDARD DEVIATIONS FOR "COLOR" COMPREHENSION IN THE IMMEDIATE AND THE ONE-WEEK RETENTION TESTS

Group	I		II		III		IV	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Immediate Retention	16.79	5.27	15.06	4.73	14.65	5.86	14.79	5.44
One-Week Retention	17.91	5.27	16.62	5.55	15.50	6.09	15.82	5.86

Tables 29 to 32 present the summaries of the analysis of variance and of covariance of the scores for "color" comprehension in the immediate and the one-week retention tests. The significance of the differences among the group means was slightly below the level of P = .25. In "color" comprehension, the analysis of covariance which controlled the variance due to the SCAT scores tended to give lower values of F.

TABLE 29

ANALYSIS OF VARIANCE OF SUMMED SCORES FOR "COLOR" COMPREHENSION IN THE IMMEDIATE RETENTION TEST

Source	Sum of Squares	df	Mean Square	F Ratio
Between Groups	101.00	3	33.67	1.19
Within Groups	3732.76	132	28.28	
Total	3833.76	135		

TABLE 30

ANALYSIS OF COVARIANCE OF SUMMED SCORES FOR "COLOR" COMPREHENSION IN THE IMMEDIATE RETENTION TEST

Source	Sum of Squares	df	Mean Square	F Ratio
Between Groups	86.54	3	28.85	1.13
Within Groups	3338.63	131	25.49	
Total	3425.17	134		

TABLE 31

ANALYSIS OF VARIANCE OF SUMMED SCORES FOR "COLOR" COMPREHENSION IN THE ONE-WEEK RETENTION TEST

Source	Sum of Squares	df	Mean Square	F Ratio
Between Groups	117.61	3	39.20	1.24
Within Groups	4178.21	132	31.65	
Total	4295.82	135		

TABLE 32

ANALYSIS OF COVARIANCE OF SUMMED SCORES FOR "COLOR" COMPREHENSION IN THE ONE-WEEK RETENTION TEST

Source	Sum of Squares	df	Mean Square	F Ratio
Between Groups	98.30	3	32.77	1.20
Within Groups	3580.17	131	27.33	
Total	3678.47	134		

As shown in Table 33, no significant differences existed between Experimental Groups I and II and between III and IV. Hypotheses 3 and 4 were not confirmed in "color" comprehension. However, the differences between Experimental Groups I and III and between I and II combined and III and IV combined tended to be more significant one week later than immediately after training, Hypothesis 1 was generally supported in "color" comprehension in both the immediate and the one-week retention tests.

TABLE 33

SIGNIFICANCE TEST FOR "COLOR" COMPREHENSION

Groups Compared	Mean (First Group)	Mean (Second Group)	s_d*	t	P
Immediate Retention					
I vs. II	16.79	15.06	1.29	1.34	.10
I vs. III	16.79	14.65	1.29	1.66	.05
I and II vs. III and IV	31.85	29.44	1.82	1.32	.10
III vs. IV	14.64	14.79	1.29	-0.11	NS
One-Week Retention					
I vs. II	17.91	16.62	1.36	0.95	.20
I vs. III	17.91	15.82	1.36	1.77	.05
I and II vs. III and IV	34.53	31.32	1.93	1.66	.05
III vs. IV	15.50	15.82	1.36	-0.24	NS

*s_d: standard error of a comparison based on the error mean square of the analysis of variance.

df = 132

"Figure" comprehension:

Table 34 shows that Experimental Group I had the highest means and that Experimental Group IV had the lowest means among the four.

TABLE 34

MEANS AND STANDARD DEVIATIONS FOR "FIGURE" COMPREHENSION IN THE IMMEDIATE AND THE ONE-WEEK RETENTION TESTS

Groups	I		II		III		IV	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Immediate Retention	17.68	4.60	16.06	3.76	15.09	4.49	14.59	5.39
One-Week Retention	18.94	4.06	17.79	5.10	17.74	4.64	15.62	5.12

Tables 36 to 39 present the summaries of the analysis of variance and covariance of the scores for "figure" comprehension in the immediate and the one-week retention tests. The significance of the differences among the group means reached the level of P = .05 or better. In contrast to "color" comprehension, the analysis of covariance for "figure" comprehension, in which the variance due to the SCAT scores was controlled, resulted in higher values of F (Table 35), indicating that "figure" comprehension was more dependent than "color" comprehension on mental ability as measured by SCAT.

TABLE 35

COMPARISON OF VALUES OF F BY THE ANALYSIS OF VARIANCE AND COVARIANCE ON THE MEASURE OF "FIGURE" COMPREHENSION IN THE IMMEDIATE AND ONE-WEEK RETENTION TESTS

Type of Analysis	Immediate Retention	One-Week Retention
Analysis of Variance	2.98*	2.89*
Analysis of Covariance	3.07*	3.60**

*P = .05
**P = .025

TABLE 36

ANALYSIS OF VARIANCE OF SUMMED SCORES FOR "FIGURE" COMPREHENSION IN THE IMMEDIATE RETENTION TEST

Source	Sum of Squares	df	Mean Square	F Ratio
Between Groups	188.77	3	62.92	2.98*
Within Groups	2790.29	132	21.14	
Total	2979.06	135		

*Significant at P = .05

TABLE 37

ANALYSIS OF COVARIANCE OF SUMMED SCORES FOR "FIGURE" COMPREHENSION IN THE IMMEDIATE RETENTION TEST

Source	Sum of Squares	df	Mean Square	F Ratio
Between Groups	180.29	3	60.10	3.07*
Within Groups	2565.16	131	19.58	
Total	2745.45	134		

*Significant at P = .05

TABLE 38

ANALYSIS OF VARIANCE OF SUMMED SCORES FOR "FIGURE" COMPREHENSION IN THE ONE-WEEK RETENTION TEST

Source	Sum of Squares	df	Mean Square	F Ratio
Between Groups	195.85	3	65.28	2.89*
Within Groups	2978.09	132	22.56	
Total	3173.94	135		

*Significant at P = .05

TABLE 39

ANALYSIS OF COVARIANCE OF SUMMED SCORES FOR "FIGURE" COMPREHENSION IN THE ONE-WEEK RETENTION TEST

Source	Sum of Squares	df	Mean Square	F Ratio
Between Groups	209.08	3	69.69	3.60**
Within Groups	2535.88	131	19.36	
Total	2744.96	134		

**Significant at P = .025

When the t-test was performed between groups as shown in Table 40, no significant differences were found between Experimental Groups I and II in both the immediate and the one-week retention tests. Hypothesis 3 was not confirmed. Experimental Group III excelled Experimental Group IV on the one-week retention test with a difference which was significant at the .05 level. Hypothesis 4 was supported one week after training. The differences between Experimental Groups I and III and between I and II combined and III and IV combined generally reached satisfactory levels of significance on both the immediate and one-week retention tests. Hypothesis 1 was statistically supported for "figure" comprehension.

TABLE 40

SIGNIFICANCE TEST FOR "FIGURE" COMPREHENSION

Groups Compared	Mean (First Group)	Mean (Second Group)	s_d*	t	P
Immediate Retention					
I vs. II	17.68	16.06	1.11	1.46	.10
I vs. III	17.68	15.09	1.11	2.33	.025
I and II vs. III and IV	33.74	29.68	1.57	2.58	.01
III vs. IV	15.09	14.59	1.11	0.45	NS
One-Week Retention					
I vs. II	18.94	17.79	1.15	1.00	.20
I vs. III	18.94	17.73	1.15	1.05	.15
I and II vs. III and IV	36.73	33.35	1.63	2.07	.025
III vs. IV	17.73	15.62	1.15	1.84	.05

*s_d: standard error of a comparison based on the error mean square of the analysis of variance.

df = 132

IV. REMINISCENCE

In Table 41 the means and standard deviations for listening and reading comprehension in the one-week retention test are presented next to those from the immediate retention test for ease of comparison. All four treatment groups uniformly showed higher means in all categories of measure one week later than immediately after training.

The difference between the means in the immediate and the one-week retention tests was tested for significance by the t-test for correlated means (McNemar, 1962, p. 101). Tables 42 to 48 present the results of the t-test with the means and the reliability coefficient for each type of measure. Since no prediction was made before the study was conducted, the levels of significance shown on the tables are based on the two-tailed test.

Tables 42 and 43 indicate that Experimental Groups III and IV, which were trained with graphemic representations, tended to show greater amount of reminiscence in both "perceptual" choice and "graphemic" choice measures than Experimental Groups I and II. They both showed significantly better comprehension of Japanese words when they were required to indicate it by choosing proper English words (or graphemic representations) with which they were trained.

However, in "writing" and "reading" measures (Tables 44 and 46) Experimental Groups I and II, which were trained with perceptual representations tended to show not only higher initial scores immediately after training but also a greater amount of reminiscence one week later than Experimental Groups III and IV.

Generally, reminiscence in *"color" comprehension* was not large (Table 46). In contrast, *"figure" comprehension* showed significant amounts of reminiscence, one week after training (Table 47). When the total scores were compared between those obtained immediately after training and those obtained one week later, the differences were generally significant at the .01 to .02 levels for all four treatment groups (Table 48).

TABLE 41

MEANS AND STANDARD DEVIATIONS FOR LISTENING AND READING COMPREHENSION IN THE IMMEDIATE AND THE ONE-WEEK RETENTION TESTS

Group	I		II		III		IV	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
"Perceptual" Choice	8.97	2.18	8.44	2.35	7.88	2.85	7.71	2.60
	9.24*	2.19	8.68	2.92	8.76	2.59	8.06	2.73
"Color" Choice	4.35	1.50	4.06	1.43	3.71	1.80	3.74	1.56
	4.44	1.46	4.18	1.71	4.12	1.77	3.97	1.64
"Figure" Choice	4.62	1.21	4.38	1.18	4.18	1.45	3.97	1.45
	4.79	1.09	4.50	1.52	4.65	1.20	4.09	1.38
"Graphemic" Choice	9.15	2.61	8.50	2.40	7.88	2.58	7.82	2.66
	9.29	2.53	8.62	2.74	8.68	2.37	8.50	2.30
"Color" Choice	4.38	1.58	4.18	1.40	4.03	1.66	3.97	1.36
	4.44	1.58	4.15	1.50	3.85	1.54	4.21	1.47
"Figure" Choice	4.76	.30	4.32	1.34	3.85	1.33	3.85	1.64
	4.85	1.16	4.47	1.42	4.82	1.19	4.29	1.09
"Writing"	6.79	3.45	5.29	2.66	5.68	2.90	5.76	3.38
	7.79	3.24	6.91	2.98	6.56	3.39	6.06	3.54
"Color" Choice	3.24	1.83	2.74	1.48	2.74	1.80	2.91	1.83
	3.82	1.82	3.47	1.67	2.97	2.12	3.24	1.76
"Figure" Choice	3.56	1.83	2.56	1.56	2.94	1.54	2.85	1.96
	3.97	1.68	3.44	1.69	3.59	1.54	2.32	1.98
"Reading"	9.56	1.99	8.88	2.11	8.29	2.84	8.09	2.61
	10.50	1.96	10.15	2.64	9.24	2.96	8.82	2.98
"Color" Comprehension	16.79	5.17	15.06	4.73	14.65	5.86	14.79	5.44
	17.91	5.27	16.62	5.55	15.50	6.09	15.82	5.56
"Figure" Comprehension	17.68	4.60	16.06	3.76	15.09	4.49	14.59	5.39
	18.94	4.06	17.79	5.10	17.74	4.74	15.62	4.12
Total Comprehension	34.47	9.23	31.24	8.07	29.76	9.68	29.38	10.02
	36.85	8.93	34.41	10.05	32.94	10.30	31.44	10.38

*Underlined figures are from the one-week retention test.

TABLE 42

SIGNIFICANCE TEST BETWEEN THE IMMEDIATE AND ONE-WEEK RETENTION IN "PERCEPTUAL" CHOICE

Group	Mean (Immediate)	Mean (One-Week)	r_{xx}*	s_d**	t	p***
	8.97	9.24	.69	.297	.89	NS
II	8.44	8.68	.64	.396	.59	NS
III	7.88	8.76	.61	.414	2.13	.05
IV	7.71	8.06	.77	.311	1.13	NS

*r_{xx}: reliability coefficient

**s_d: standard error of difference between correlated means

***p: two-tailed

TABLE 43

SIGNIFICANCE TESTS BETWEEN THE IMMEDIATE AND ONE-WEEK RETENTION IN "GRAPHEMIC" CHOICE

Group	Mean (Immediate)	Mean (One-Week)	r_{xx}	s_d	t	p
I	9.15	9.29	.52	.400	.37	NS
II	8.50	8.62	.68	.359	.33	NS
III	7.88	8.68	.74	.308	2.58	.02
IV	7.82	8.50	.71	.327	2.07	.05

TABLE 44

SIGNIFICANCE TEST BETWEEN THE IMMEDIATE AND ONE-WEEK RETENTION IN "WRITING"

Group	Mean (Immediate)	Mean (One-Week)	r_{xx}	s_d	t	p
I	6.79	7.79	.81	.355	2.82	.01
II	5.29	6.91	.64	.411	3.94	.001
III	5.68	6.56	.67	.446	1.98	.1
IV	5.76	6.06	.80	.373	0.79	NS

TABLE 45

SIGNIFICANCE TEST BETWEEN THE IMMEDIATE AND ONE-WEEK RETENTION IN "READING"

Group	Mean (Immediate)	Mean (One-Week)	r_{xx}	s_d	t	p
I	9.56	10.50	.67	.274	3.43	.01
II	8.88	10.15	.51	.412	3.07	.01
III	8.29	9.24	.62	.431	2.18	.05
IV	8.09	8.82	.75	.344	2.14	.05

TABLE 46

SIGNIFICANCE TEST BETWEEN THE IMMEDIATE AND ONE-WEEK RETENTION IN "COLOR" COMPREHENSION

Group	Mean (Immediate)	Mean (One-Week)	r_{xx}	s_d	t	p
I	16.79	17.91	.76	.616	1.81	.1
II	15.06	16.62	.73	.659	2.37	.05
III	14.65	15.50	.88	.494	0.83	NS
IV	14.79	15.82	.84	.531	1.94	.1

TABLE 47

SIGNIFICANCE TEST BETWEEN THE IMMEDIATE AND ONE-WEEK RETENTION IN "FIGURE" COMPREHENSION

Group	Mean (Immediate)	Mean (One-Week)	r_{xx}	s_d	t	p
I	17.68	18.94	.85	.412	3.07	.01
II	16.06	17.79	.80	.528	3.29	.01
III	15.09	17.74	.66	.645	4.10	.001
IV	14.59	15.62	.84	.510	2.02	.1

TABLE 48

SIGNIFICANCE TEST BETWEEN THE IMMEDIATE AND ONE-WEEK RETENTION IN TOTAL COMPREHENSION

Group	Mean (Immediate)	Mean (One-Week)	r_{xx}	s_d	t	p
I	34.47	36.85	.82	.926	2.57	.02
II	31.24	34.41	.80	1.086	2.92	.01
III	29.76	32.94	.84	.964	3.30	.01
IV	29.38	31.44	.89	.825	2.50	.02

V. RELATIONSHIPS BETWEEN MENTAL ABILITY SCORE (SCAT) AND COMPREHENSION OF JAPANESE WORDS

Table 49 presents Pearson product-moment coefficients between the mental ability scores (SCAT) and the different kinds of measures of the comprehension of Japanese words in the immediate and the one-week retention tests.

TABLE 49

CORRELATION COEFFICIENTS BETWEEN MENTAL ABILITY SCORE (SCAT) AND THE COMPREHENSION OF JAPANESE WORDS IN THE IMMEDIATE AND THE ONE-WEEK RETENTION TESTS

Group	I	II	III	IV
Immediate Retention				
"Perceptual" Choice	.25	.22	.37*	.36*
"Graphemic" Choice	.15	.27	.33	.27
"Writing"	.27	.24	.21	.34*
"Reading"	.42*	.22	.40*	.26
"Color" Comprehension	.30	.22	.37*	.38*
"Figure" Comprehension	.24	.33	.32	.26
Total	.29	.29	.37*	.35*
One-Week Retention				
"Perceptual" Choice	.35*	.25	.37*	.36*
"Graphemic" Choice	.36*	.19	.45**	.44**
"Writing"	.19	.48**	.47**	.38*
"Reading"	.41*	.20	.43*	.40*
"Color"	.34*	.29	.40*	.48**
"Figure" Comprehension	.32	.31	.54**	.36*
Total	.35*	.32	.51**	.44**

*Significant at P = .05 (two-tailed)
**Significant at P = .01 (two-tailed)

Generally, the correlation coefficients between the SCAT scores and the test scores were higher for Experimental Groups III and IV, trained with graphemic representations, in comparison to Experimental Groups I and II, trained with perceptual representations.

Experimental Group II, which was trained with perceptual representations with discriminative context (two other representations beside the proper one), consistently showed lower relationships between mental ability and the comprehension of Japanese words in comparison with the other groups. Only when subjects in this group were required to write the English equivalent for a Japanese word they heard (i.e., "writing") one week after training, their scores showed a significant correlation between mental ability and test scores.

Furthermore, Experimental Group II generally showed no increase in the values of correlation coefficients in the second retention test, while the other three groups showed higher and more significant correlation coefficients between mental ability and the comprehension of Japanese words one week after training.

VI. TEST RELIABILITY

The immediate and the one-week retention tests can be considered as parallel tests because one was simply a random arrangement of the identical items in the other. Table 50 presents the correlation coefficients between the immediate and the one-week retention tests for different kinds of measures for the four treatment groups.

The maximum possible score for each measure is indicated because a longer measure is expected to show higher reliability.

TABLE 50

RELIABILITY OF THE RETENTION MEASURES

Group	Maximum Possible Score	I	II	III	IV
"Perceptual" Choice	12	.69	.63	.61	.77
"Graphemic" Choice	12	.52	.68	.74	.71
"Writing"	12	.81	.64	.67	.80
"Reading"	12	.67	.51	.62	.75
"Color" Comprehension	24	.76	.73	.87	.84
"Figure" Comprehension	24	.85	.80	.66	.84
Total Comprehension	48	.82	.80	.84	.89

CHAPTER IV

DISCUSSION AND CONCLUSIONS

Relative effectiveness of perceptual and graphemic representations:

The first major objective of the present experiment was to determine the relative effectiveness of perceptual and graphemic representations in learning the concepts of foreign-language words. The design of the experiment required training for listening comprehension with perceptual and graphemic representations and testing for listening and reading comprehension.

Generally, training with perceptual representations resulted in better listening comprehension immediately after training when it was measured by the "perceptual" choice and "graphemic" choice measures but not the "writing" measure (Table 51). However, the difference between the subjects trained with perceptual representations and those trained with graphemic representations tended to disappear after a week except when it was measured by the "writing" measure, which showed an increase in significance instead.

The measures of reading comprehension and "figure" comprehension showed more significant differences between the subjects trained with perceptual representations and those trained with graphemic representations both immediately after training and one week later (Table 51). It is also observed that the measures of "writing", "color" comprehension, "figure" comprehension, and reading comprehension either increased or maintained the level of significance from immediately after training to one week later.

TABLE 51

COMPARISON OF VALUES OF F FOR COLUMN EFFECTS
IN THE IMMEDIATE AND ONE-WEEK RETENTION TESTS

Measure	Immediate Retention	One-Week Retention
"Perceptual" Choice	4.49***	1.39*
"Graphemic" Choice	4.87***	---
"Writing"	---	3.42**
"Color" Comprehension	1.75*	2.76**
"Figure" Comprehension	6.62****	4.31***
Reading Comprehension	6.18****	7.80*****
Total Comprehension	4.25***	4.08***

*P = .25
**P = .10
***P = .05
****P = .025
*****P = .01

These measures seem to measure somewhat different aspects of verbal comprehension than the other two measures ("perceptual" choice and "graphemic" choice).

The correlation coefficients between the scores on different measures and the SCAT scores were mostly non-significant for the subjects trained with perceptual representations (Table 51). From these coefficients it was not possible to decide whether one measure was more related to mental ability as measured by *SCAT* than another. However, the higher values of F obtained by the analysis of covariance as compared to the analysis of variance for column effects on the measures of *reading comprehension* and *"figure" comprehension* (Table 52) indicated that the scores on these measures were positively related to the *SCAT* scores.

It may be suggested that, while all subjects trained with perceptual representations showed superior verbal comprehension immediately after training as compared with those trained with graphemic representations, those with higher mental ability (higher verbal ability) would show greater differences one week later. Further studies must be designed to probe the long-term effects of training with perceptual representations. The interaction among the level of *mental ability*, the kind of *representations*, and the type of measures must be explored in future studies.

The perceptual representations used in this study were not of a single category. They included colors, line drawings of common objects, and geometric figures. The only comparison made in the statistical analysis in this study was between *"color" comprehension* and *"figure" comprehension*. The subjects trained with perceptual representations generally showed greater superiority over the subjects trained with graphemic representations in *"figure" comprehension* than in *"color" comprehension* (Tables 33 and 40). Additional studies involving a single

TABLE 52

COMPARISON OF VALUES OF F BY ANALYSIS OF VARIANCE AND COVARIANCE IN THE IMMEDIATE AND ONE-WEEK RETENTION TESTS

	Immediate Retention		One-Week Retention	
Measure	Analysis of Variance	Analysis of Covariance	Analysis of Variance	Analysis of Covariance
"Perceptual" Choice	1.78*	1.84*	1.23	1.48*
"Graphemic" Choice	1.99*	1.97*	0.85	0.89
"Writing"	1.44*	1.38	1.68*	1.88*
"Color" Comprehension	1.19	1.13	1.24	1.20
"Figure" Comprehension	2.98***	3.07***	2.89***	3.60****
Reading Comprehension	2.55**	2.68***	2.90***	3.24****
Total Comprehension	2.11*	2.16**	1.83*	2.11*

*P = .25
**P = .10
***P = .05
****P = .025

category of perceptual representations in each of the studies should give more information on the relative effectiveness of different categories of perceptual representations. Comparisons between mixed and single categories of perceptual representations should also be made (the design of this study did not permit such an analysis).

Training with perceptual representations is obviously less dependent on verbal ability than training with graphemic representations. The scores of the subjects trained with graphemic representations generally showed higher correlation coefficients between various measures of listening and reading comprehension and the SCAT scores than those trained with perceptual representations. Many of the coefficients were significant at P = .05 immediately after training. They were even higher one week later (Table 49). This is understandable since the SCAT score is heavily dependent on verbal ability. This increase in correlation one week after training between the measures of listening and reading comprehension and the SCAT scores was also observed for those who were trained with perceptual representations. However, the indication seems clear that the development and retention of listening and reading comprehension is more dependent on the subject's mental ability when he is trained with graphemic representations than with perceptual representations.

Influence of discriminative context:

This study was designed as an exploratory investigation of the influence of the discriminative context. The discriminative contest employed included perceptual representations of different categories, namely, colors and line-drawings of geometric figures and common objects. However, the context actually probably functioned very little as a discriminative context since the relevant stimulus was always indicated with an arrow. The subject could simply look for an arrow and then focus his attention solely on the representation thus indicated. Any perceptual or conceptual influence exerted by the other stimuli in the context was more or less incidental.

The same may be said of those who were trained with graphemic representations. The subjects who were sixth graders should be able to pay attention only to the English word (graphemic representation) indicated with an arrow and ignore the others in the context.

However, the results of the study generally suggested that the influence of the context was interfering, though the obtained differences between the groups with discriminative context and without discriminative context did not reach an acceptable level of significance.

Additional studies on the influence of discriminative context should be conducted with perceptual representations of a single category (e.g., colors or geometric figures). It is also essential that the subject should be required to make a choice from among several alternatives so that he must discriminate the relevant stimulus from others.

Listening comprehension:

This study was primarily concerned with the development of listening comprehension. The paradigm of training called for learning from modified paired associate lists in which the stimulus term (foreign-language word) was heard by the subject and the response term (perceptual or graphemic representation) was presented visually. This paradigm of learning is by no means the most powerful one, but the results generally indicated strong and lasting listening comprehension. In fact, a number of subjects in all experimental groups reached the maximum possible score on some or all of the measures of listening and reading comprehension, on both immediate and the one-week retention tests.

This is remarkable in view of the fact that the subjects were allowed very little active part in learning. They were not allowed to pronounce foreign-language words. They did not call aloud or write graphemic representations. They simply listened to a tape recording and read the training booklets. This seemingly passive learning situation nevertheless resulted in sufficiently strong listening comprehension.

The child spends the first few years mainly in listening to adult utterances. His listening comprehension far exceeds his ability to speak in the early stage of language development. However, in the audio-lingual method of learning a second-language, it is customary to encourage the student from the beginning to imitate the instructor's pronunciation of foreign-language utterances. The student is usually not given sufficient opportunity for simply listening to foreign-language utterances. Initial development of listening comprehension alone is usually not emphasized.

However, one of the implications of this study is that listening may be a very powerful avenue of learning, and listening comprehension can be enduring learning. This is further attested by the phenomenon of reminiscence which showed significantly higher retention scores a week later than immediately after training. However, as has been mentioned, the power of listening in verbal learning must be tested over a longer period of time than allowed in this study.

Further studies employing listening as an avenue of learning must be designed to determine the optimum arrangement under which listening comprehension may be developed. For instance, listening (e.g., sound of "aka") may be followed by the graphemic or perceptual representation (as in this study) by listening (e.g., sound of "red"), by the perceptual representation and listening (e.g., red color and sound of "red"), or by the perceptual representation and performance (e.g., picking up red paper), etc.

Reading comprehension

This study showed that direct transfer may take place from listening comprehension to reading comprehension at least on the single-word utterance level when the orthography of the second language is very similar to that of one's native language.

During training the subjects were not allowed to pronounce the foreign-language words. They heard the foreign-language words but did not see the orthographic transcriptions of these words. They read the orthographic transcriptions (or Romanized spelling) of these words for the first time in the test after training. However, the subjects showed no more difficulty in understanding what they read (or Japanese words in Romanized spelling) than what they heard (or Japanese words pronounced by a native speaker) in the test.

One implication is that an effective training in listening comprehension may go a long way in helping the student in the development of reading comprehension if the foreign-language is presented in orthography similar to one's native language.

Reminiscence

Generally the scores on the one-week retention test were significantly higher than those on the immediate retention test for all experimental groups. This is remarkable in view of the fact that the subjects were not corrected for wrong responses they made in the immediate retention test and did not have an opportunity to hear the Japanese words again until the one-week retention test. The higher scores in the second retention test were due to correct responses made where the last responses made were wrong.

CONCLUSIONS

The following conclusions were drawn from the results of the present study:

1. Training with perceptual representations resulted in superior listening comprehension of the Japanese words used in this experiment than training with graphemic representations when measured immediately after training by the ability to choose proper perceptual representations ("perceptual" choice) and graphemic representations ("graphemic" choice). However, the superiority in listening comprehension thus measured largely disappeared one week after training.

Hypothesis 1 was confirmed by the results of the immediate retention test.

2. Training with perceptual representations resulted in superior listening comprehension of the Japanese words used in this experiment than training with graphemic representations when measured one week after training by the ability to write the English equivalent for a Japanese word ("writing").

Hypothesis 1 was confirmed by the results of the one-week retention test.

3. Training with perceptual representations resulted in superior reading comprehension of the Japanese words used in this experiment compares to training with graphemic representations when it was measured both immediately after training and one week later.

Hypothesis 2 was confirmed by the results of both the immediate and one-week retention tests.

4. Training with or without discriminative context of perceptual representations did not result in significant differences in listening comprehension either immediately after training or one week later.

Hypothesis 3 was not confirmed.

5. Training with or without discriminative context of graphemic representations did not result in significant differences in listening comprehension either immediately after training or one week later.

Hypothesis 4 was not confirmed.

6. Training with graphemic representations without discriminative context resulted in better listening comprehension of "figure" names than training with discriminative context of graphemic representations when it was measured one week after training.

Hypothesis 4 was confirmed in the one-week retention test for "figure" name.

7. There seems to be direct transfer from listening comprehension to reading comprehension when similarity of orthography exists between the second language and the native language.

8. Training with perceptual representations generally resulted in more significant reminiscence one week after training than training with graphemic representations.

9. Reminiscence for "figure" names was generally more significant than reminiscence for color names.

10. Training with perceptual representations not only resulted in better listening comprehension but depended less on

mental ability than training with graphemic representation. However, the development of more permanent listening comprehension seems to depend on mental ability whether training is done with perceptual or graphemic representations.

Implications for verbal learning and further investigation:

1. Verbal learning begins with listening in humans, and a verbal learning paradigm involving listening applied to training probably will result in lasting verbal comprehension (both listening and reading). Experimentation in verbal learning should incorporate listening in its designs in order to explore the function and nature of listening in human learning.

2. Verbal learning paradigms with two different modes of stimulus input (e.g., listening and perceptual representations, as in this study) when applied may result in superior retention, greater than that achieved by applying paradigms with one mode of stimulus input (e.g., traditional paired-associate studies with both the stimulus and response terms presented in printed form).

Verbal learning must be studied by comparing single modes of stimulus input (e.g., visual) and different modes of stimulus input (e.g., visual versus auditory).

Paradigms which involve within-mode comparisons may include the following:

Visual

(1) Graphemic representation -- graphemic representation (e.g., nonsense syllable -- English word).

(2) Graphemic representation -- perceptual representation (e.g., nonsense syllable -- patch of color).

Auditory

(1) Listening -- listening (e.g., sound of "aka" -- sound of "red").

Paradigms which involve between-mode comparisons may include the following:

Visual-auditory or auditory-visual

(1) Graphemic representation -- listening (e.g., AKA -- sound of "red").

(2) Perceptual representation -- listening (e.g., patch of red -- sound of "aka").

Auditory-performance

(1) Listening -- performance (e.g., sound of "yaburu" -- tearing paper).

Visual-performance

(1) Graphemic representation -- performance (e.g., YABURU -- tearing paper).

Implications for foreign-language teaching and further studies:

1. Pupils with both high verbal ability and low verbal ability seem to develop better listening comprehension with perceptual representations than with graphemic representations. However, the relative effectiveness of different categories of perceptual representations must be further investigated as suggested by the comparison of "color" and "figure" comprehension in this study.

2. Initial emphasis on the development of listening comprehension not only seems natural according to the pattern of language development in early childhood but seems wise because listening comprehension may be developed with apparent ease to considerable strength with the aid of perceptual representations as indicated by a number of subjects reaching the maximum possible score and by significant reminiscence.

3. Initial emphasis on the development of listening comprehension seems to be justified further by direct transfer from listening comprehension to reading comprehension when similarity of orthography exists between the second language and the native language.

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APPENDIX A

EXERCISE SHEETS

Matching Exercise

Draw a line between each word and the picture or color it represents.

1. Blue

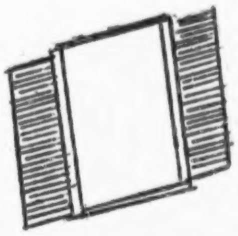
2. Chair

3. Yellow

4. Circle

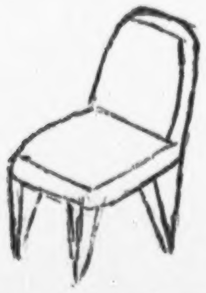
5. Window

6. Green

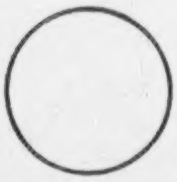


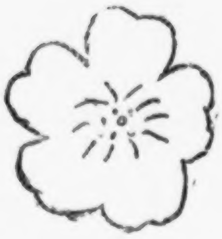
GREEN

BLUE

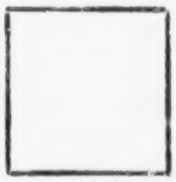


YELLOW



1. Square 

2. Red BLACK

3. Flower 

4. Star ORANGE

5. Black RED

6. Orange

APPENDIX B

THE WORD LIST FOR THE LANGUAGE TEACHING BOOKLET

I. The Word List for Condition 1

1. Blue
2. Square
3. Chair
4. Flower
5. Red
6. Orange
7. Circle
8. Window
9. Yellow
10. Star
11. Green
12. Black
13. Chair
14. Circle
15. Red
16. Flower
17. Orange
18. Window
19. Green
20. Star
21. Black
22. Blue
23. Square
24. Yellow
25. Window
26. Green
27. Star
28. Red
29. Circle
30. Chair
31. Yellow
32. Orange
33. Black
34. Square
35. Blue
36. Flower
37. Square
38. Blue
39. Flower
40. Red

41 Chair

42. Yellow
43. Black
44. Window
45. Green
46. Circle
47. Orange
48. Star

II. The Word List for Condition 2

1.	Black	Blue	Red
2.	Square	Circle	Window
3.	Orange	Chair	Green
4.	Yellow	Blue	Flower
5.	Circle	Window	Red
6.	Square	Orange	Chair
7.	Green	Yellow	Circle
8.	Star	Window	Square
9.	Yellow	Flower	Chair
10.	Orange	Star	Black
11.	Green	Red	Flower
12.	Blue	Star	Black
13.	Chair	Star	Flower
14.	Window	Circle	Yellow
15.	Blue	Orange	Red
16.	Flower	Circle	Red
17.	Black	Orange	Yellow
18.	Flower	Window	Orange
19.	Green	Chair	Square
20.	Green	Blue	Star
21.	Circle	Black	Window
22.	Blue	Red	Star
23.	Black	Green	Square
24.	Chair	Yellow	Circle

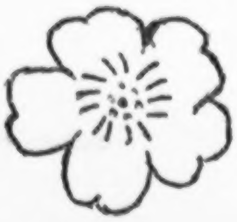
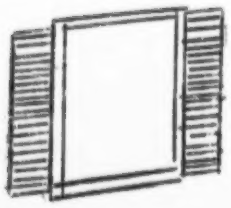
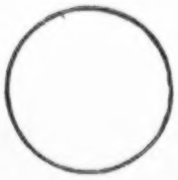
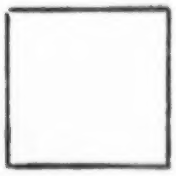
25.	Circle	Window	Red
26.	Green	Black	Flower
27.	Window	Blue	Star
28.	Chair	Red	Square
29.	Blue	Green	Circle
30.	Chair	Flower	Red
31.	Square	Yellow	Green
32.	Chair	Star	Orange
33.	Black	Circle	Flower
34.	Yellow	Square	Star
35.	Blue	Orange	Black
36.	Yellow	Window	Flower
37.	Orange	Green	Square
38.	Square	Blue	Chair
39.	Flower	Yellow	Star
40.	Window	Red	Green
41.	Chair	Flower	Black
42.	Window	Red	Yellow
43.	Orange	Black	Blue
44.	Window	Circle	Yellow
45.	Chair	Green	Black
46.	Red	Star	Circle
47.	Flower	Orange	Square
48.	Circle	Blue	Star

APPENDIX C

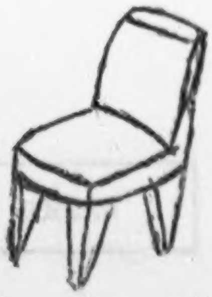
EXERCISE SHEETS FOR JAPANESE WORDS I

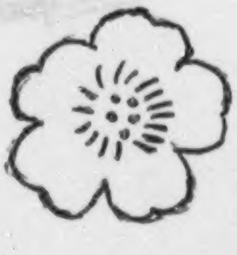
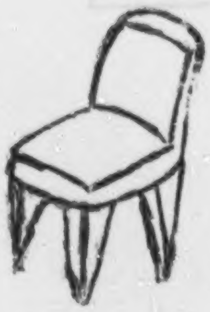
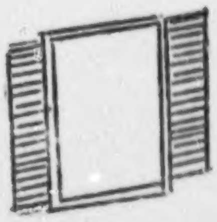
1. ( ) Orange ( ) Flower ( ) Circle ( ) Red

2. ____________

3. ( )  ( )  ( )  ( ) 

4. ( ) Window ( ) Circle ( ) Black ( ) Flower

5. ( ) BLACK ( ) ORANGE ( ) YELLOW ( ) 

6. ( ) YELLOW ( )  ( )  ( ) 

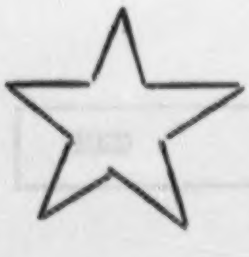
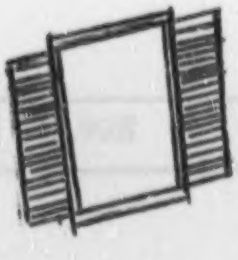
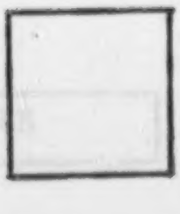
1. ____________

2. ( ) Window ( ) Circle ( ) Yellow ( ) Chair

3. ____________

4. ( ) Window ( ) Blue ( ) Star ( ) Red

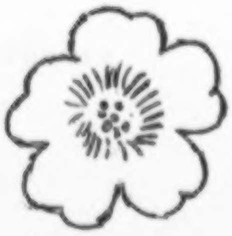
5. ____________

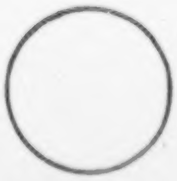
6. ( )

( )

( )

( ) GREEN

1. ( ) Square ( ) Yellow ( ) Circle ( ) Green

2. ____________

3. ( ) Black ( ) Blue ( ) Red ( ) Yellow

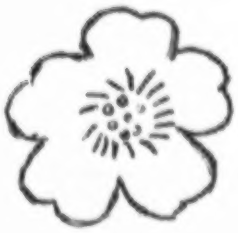
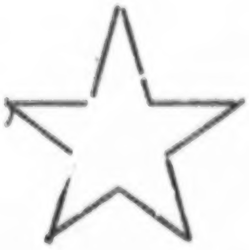
4. ( ) BLACK ( ) ( )  ( ) RED

5. ( ) BLUE ( ) GREEN ( ) YELLOW ( ) 

6. ( ) RED ( ) ORANGE ( ) BLUE ( ) BLACK

1. ______________

2. ( ) Green ( ) Black ( ) Orange ( ) Yellow

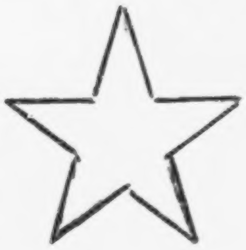
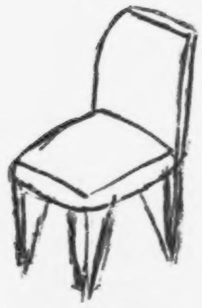
3. ( ) YELLOW ( ) BLUE ( )  ( ) 

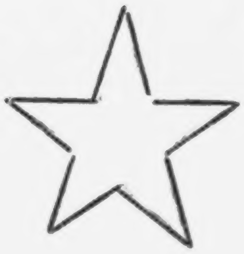
4. ( ) Chair ( ) Red ( ) Square ( ) Orange

5. ______________

6. ( ) Chair ( ) Orange ( ) Green ( ) Square

1. ____________

2. ( )  ( ) GREEN ( )  ( )

3. ( ) GREEN ( ) ORANGE ( )  ( ) BLACK

4. ____________

5. ( ) Flower ( ) Window ( ) Orange ( ) Yellow

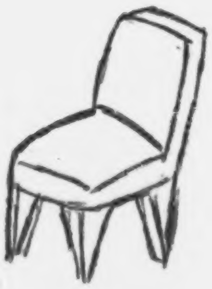
6. ____________

1. ____________

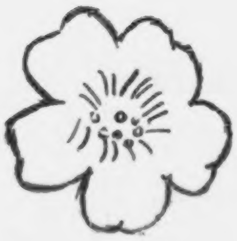
2. ( ) Green ( ) Red ( ) Flower ( ) Circle

3. ____________

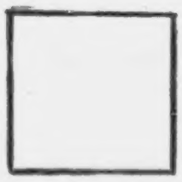
4. ( )



( )



( ) RED ( )



5. ( ) Black ( ) Square ( ) Green ( ) Star

6 ( ) BLACK ( ) BLUE ( ) RED ( ) GREEN

Check the correct English meaning for each Japanese word.

Japanese Word	English Meaning		
1. Hoshi	( ) Green	( ) Blue	( ) Star
2. Mikan	( ) Black	( ) Orange	( ) Yellow
3. Keyro	( ) Chair	( ) Yellow	( ) Circle
4. Midori	( ) Green	( ) Chair	( ) Square
5. Mado	( ) Flower	( ) Window	( ) Orange
6. Kuro	( ) Circle	( ) Black	( ) Window
7. Maru	( ) Window	( ) Circle	( ) Yellow
8. Isu	( ) Chair	( ) Star	( ) Flower
9. Aka	( ) Blue	( ) Orange	( ) Red
10. Hana	( ) Flower	( ) Circle	( ) Red
11. Awo	( ) Blue	( ) Red	( ) Star
12. Shikaku	( ) Black	( ) Green	( ) Square

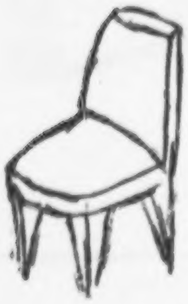
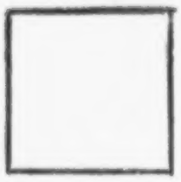
APPENDIX D

EXERCISE SHEETS FOR JAPANESE WORDS II

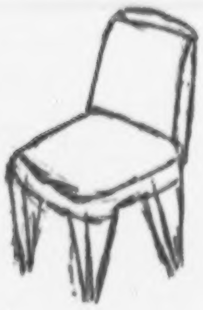
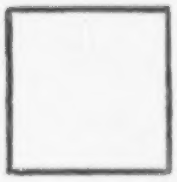
1. ( ) Circle ( ) Window ( ) Red ( ) Green

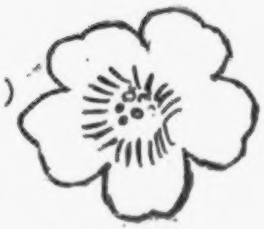
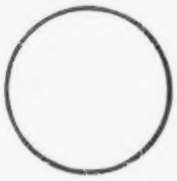
2. ( ) GREEN ( ) BLACK ( ) ORANGE ( ) YELLOW

3. ______________

4. ( )  ( ) RED ( )  ( ) ORANGE

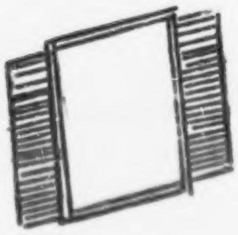
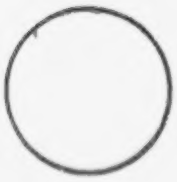
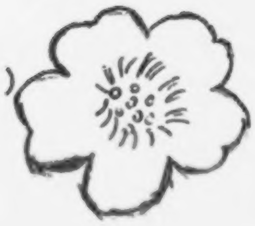
5. ( ) Blue ( ) Window ( ) Yellow ( ) Circle

6. ( )  ( ) ORANGE ( ) GREEN ( ) 

1. ( ) ORANGE ( )  ( )  ( ) RED

2. ( ) Blue ( ) Orange ( ) Black ( ) Window

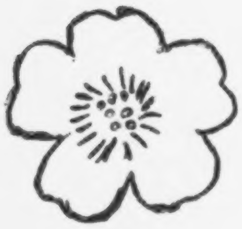
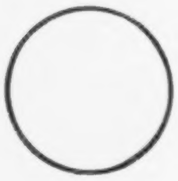
3. ______________

4. ( )  ( )  ( ) BLACK ( ) 

5. ______________

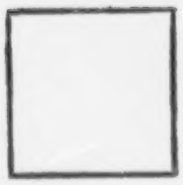
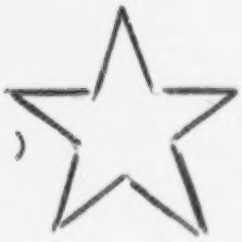
6. ______________

1. ( ) Black ( ) Green ( ) Blue ( ) Star

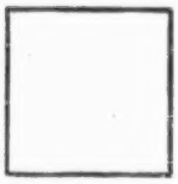
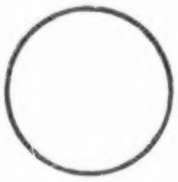
2. ( ) GREEN ( ) RED ( )  ( ) 

3. ( ) Yellow ( ) Blue ( ) Flower ( ) Circle

4. ____________

5. ( ) BLACK ( )  ( ) GREEN ( ) 

6. ____________

1. ( )  ( ) YELLOW ( )  ( ) GREEN

2. ( ) Blue ( ) Black ( ) Green ( ) Square

3. ( ) BLACK ( ) BLUE ( ) RED ( ) YELLOW

4. ____________________

5. ____________________

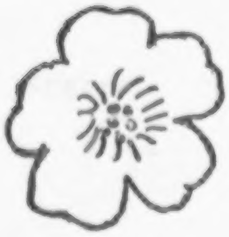
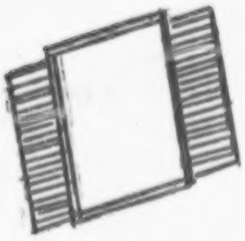
6. ____________________

1. ( ) Black ( ) Circle ( ) Flower ( ) Chair

2. ______________

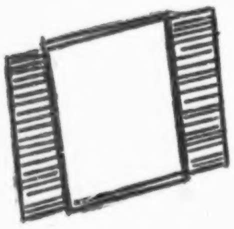
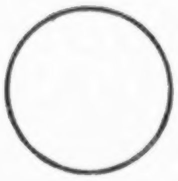
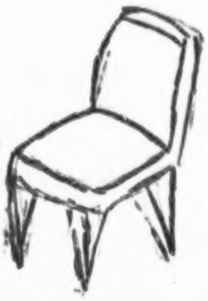
3. ______________

4. ( ) Black ( ) Square ( ) Green ( ) Yellow

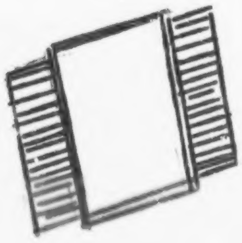
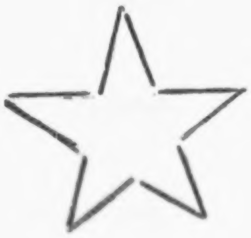
5. ( )  ( )  ( ) ORANGE ( ) YELLOW

6. ( ) Chair ( ) Star ( ) Orange ( ) Yellow

1. ( ) Chair ( ) Flower ( ) Red ( ) Orange

2. ( )  ( )  ( ) YELLOW ( ) 

3. ( ) Circle ( ) Window ( ) Red ( ) Square

4. ( )  ( ) BLUE ( )  ( ) RED

5. ( ) Green ( ) Chair ( ) Square ( ) Flower

6. ____________

Check the correct English meaning for each Japanese word.

Japanese Word	English Meaning		
1. Hana	( ) Yellow	( ) Window	( ) Flower
2. Awo	( ) Blue	( ) Orange	( ) Black
3. Shikaku	( ) Yellow	( ) Square	( ) Star
4. Kuro	( ) Black	( ) Circle	( ) Flower
5. Mikan	( ) Chair	( ) Star	( ) Orange
6. Keyro	( ) Square	( ) Yellow	( ) Green
7. Isu	( ) Chair	( ) Flower	( ) Red
8. Maru	( ) Blue	( ) Green	( ) Circle
9. Aka	( ) Chair	( ) Red	( ) Square
10. Hoshi	( ) Window	( ) Blue	( ) Star
11. Midori	( ) Green	( ) Black	( ) Flower
12. Mado	( ) Circle	( ) Window	( ) Red